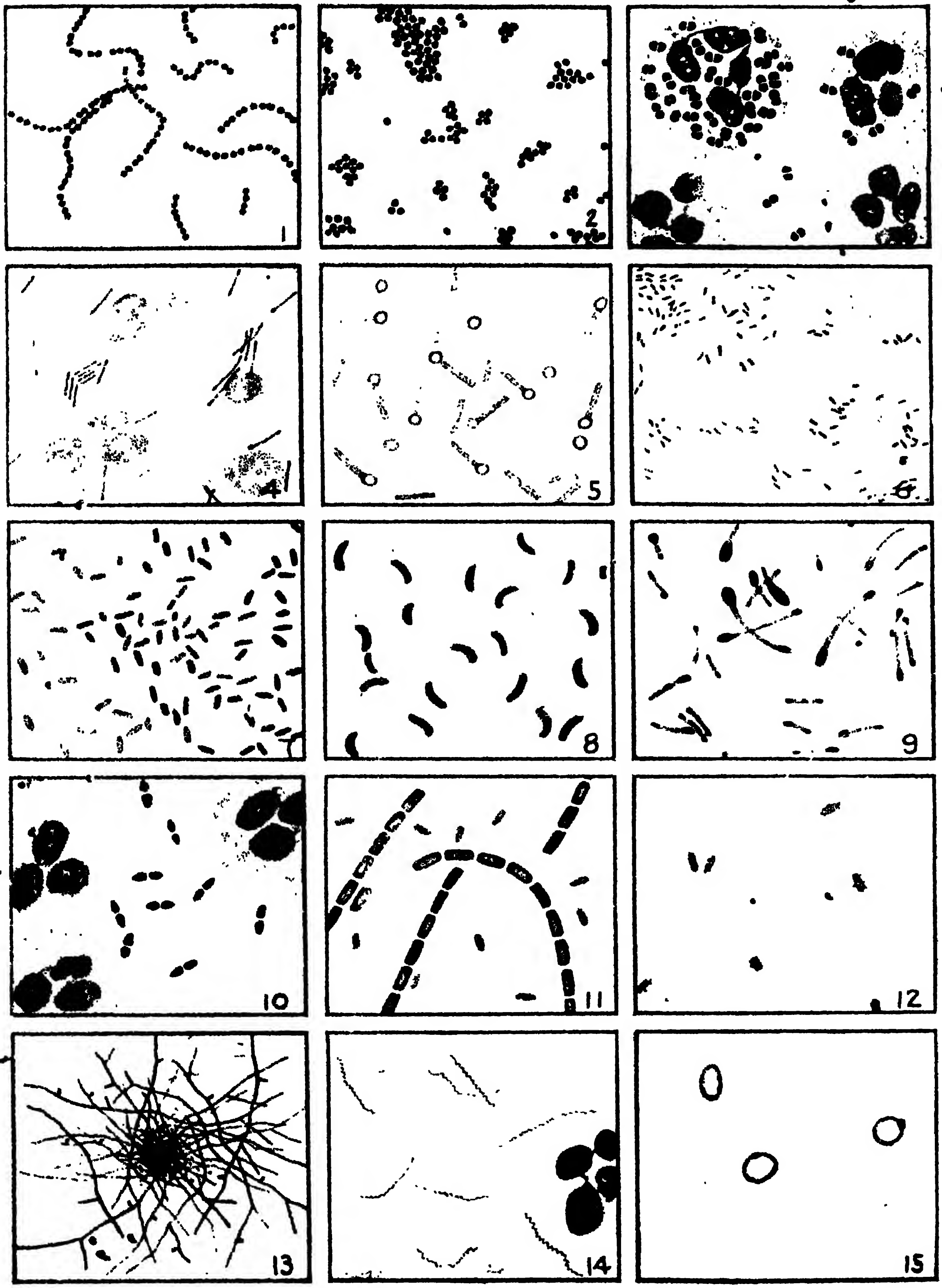
THE GERM LIFE WITHIN US



The various types of bacteria and the diseases they cause: 1, 2, and 3, the globular cocci in chains, bunches and pairs; 3, gonorrhœa; 4, tuberculosis (rod-shaped bacilli in sputum); 5, tetanus; 6, influenza; 7, colitis (common intestinal bacillus); 8, cholera (comma-shaped vibrios); 9, diphtheria; 10, pneumonia; 11, anthrax; 12, typhoid; 13, actinomycosis; 14, syphilis (spirochætes); 15, animal parasites of malaria (in blood).

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A Complete Guide to Golden Health for Men & Women of all Ages
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From the painting] [*By Edelfel*

THE DISCOVERER OF BACTERIAL ACTION.

Louis Pasteur at work in his laboratory.

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PLATES IN GRAVURE

Volume Four contains in addition 200 photographs and 157 drawings in black and white.

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XV
PARASITES AND DISEASE
THE GERM-LIFE WITHIN US

By GEORGE SOMERVILLE, *M.D., D.P.M., Deputy Medical Superintendent at the West Ham Mental Hospital.*

BACTERIOLOGY is the branch of biological science concerned with the study of the life-history of a group of organisms far down in the scale of living things. Members of this species are frequently referred to as "microbes," "germs," or "micro-organisms"; collectively they may be termed "bacteria." These lowly forms of life belong to the vegetable kingdom; they are plants and play a vital part, constructive and destructive, in the physiological economy of nature. Bacteria are universally distributed, and, from the record of the rocks, are believed to have existed from earliest times.

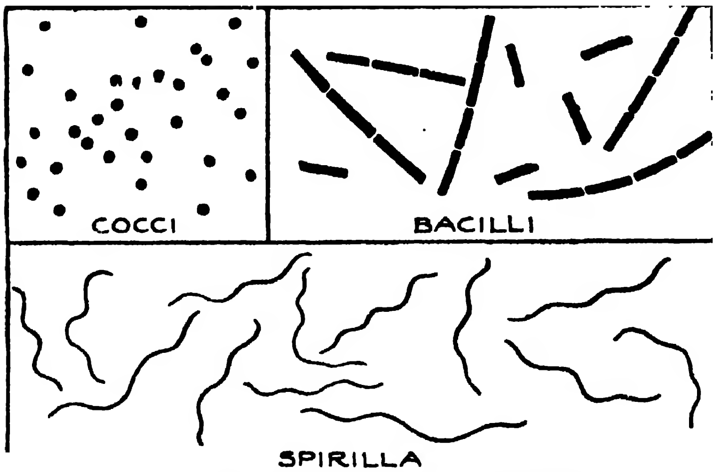
Until the middle of the nineteenth century, bacteria were regarded in the scientific world as "curiosities of the microscope." History. Liebig, the famous chemist, maintained that all fermentative and putrefactive processes were due to purely chemical changes. It was Pasteur who laid the foundations of modern bacteriology by his classical studies of yeasts and their relation to the phenomena of fermentation. By his experiments he was able to obtain pure cultures of various organisms and so render possible an accurate study of their nature and activities. Incidentally Pasteur settled the controversy regarding "spontaneous generation." Believers in this theory held that bacteria originated from organic matter as a sequence to putrefaction. Pasteur proved that all putrefaction is caused by the action of bacteria *already present*, and that, if care is taken to exclude their intrusion, fluids containing organic matter, such as milk or wine, can be preserved indefinitely.

[E.N.A.

PROFESSOR ROBERT KOCH, 1843-1910
The discoverer of the tubercle bacillus.

In 1863, the association of bacteria with disease was established by Davaine, who discovered a specific bacillus in the blood of animals suffering from anthrax. This relationship was further investigated by Pasteur who thus paved the way to the subsequent advances in the science of the causation and prevention of disease. He was followed by Koch—popularly famous for his discovery of the tubercle bacillus — scientifically respected for his invention of methods of staining and cultivation of bacteria which are universally practised to-day. The various kinds of organisms which produce suppuration in wounds, and the spirillum of cholera were also investigated by Koch.

Certain other landmarks in bacteriological history are worth recording. Towards the end of the nineteenth century, the bacillus



THE SIMPLER FORMS OF BACTERIA
Showing the three types of lower bacteria—the globular or spherical "cocci," the rod-like "bacilli" and the spiral or curved "spirilla."

of diphtheria was discovered by Klebs and Löffler; the organism of influenza by Pfeiffer and of plague by Yersin. The mosquito cycle of the malarial parasite was described by Ross in 1897; the protozoa of sleeping sickness by Castellani in 1903, and the spirochæte of syphilis in 1905 by Schaudinn and Hoffmann.

Work in Nature.

Though indirectly some varieties of bacteria, by producing deadly diseases, are inimical to life, others are all-important for the continuation of plant and animal life. Without putrefaction and decay, the earth would be encumbered with the dead remains of animals and plants and would become barren from loss of organic matter originally derived from it but not returned to it in an assimilable form. Plants and consequently animals are largely dependent for their existence upon the bacteria in the soil which not only break up and render assimilable nitrogenous matter such as manure, but are also capable of fixing atmospheric nitrogen. Industrially, bacteria are of extreme importance. The fermentation of wine and beer; the ripening of cheese and tobacco; the process of tanning and the preparation of indigo are dependent upon bacterial activity.

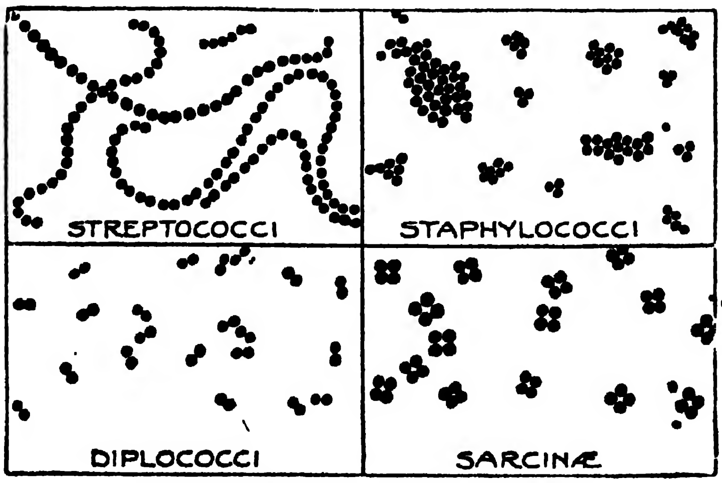
What are Bacteria?

Bacteria are minute, colourless, unicellular vegetable organisms of varying shape and size. They are surrounded by envelopes of condensed protoplasm which in some varieties assume the form of a definite capsule or sheath. Nuclei are not demonstrable. Certain species possess the power of movement.

Bacteria may be divided into two groups: the lower and simpler and the higher and better-developed. The lower forms are more numerous and multiply by simple fission. Three types are described: the coccus, the bacillus, and the spirillum.

The Cocci are globular or spherical in shape. They are classified according to their method of multiplication or division. A chain of cocci—"streptococci"—will be formed if division occurs in one axis only; a bunch of cocci—"staphylococci" will result if division takes place irregularly. The cocci may show a tendency to remain in pairs; they are then known as "diplococci." Packets of cocci, forming more or less cubical masses, are called "sarcinæ."

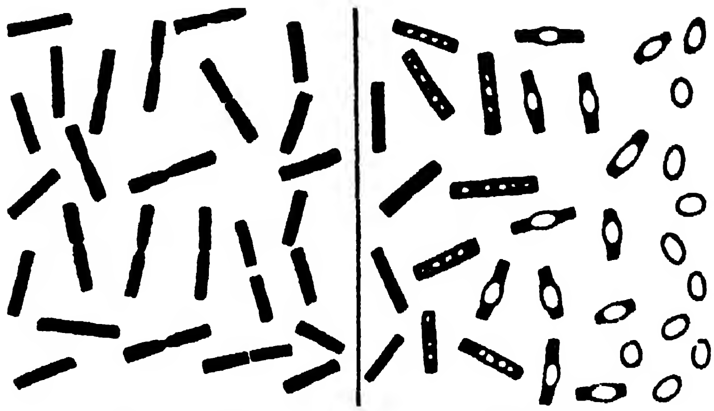
The Bacilli are cylindrical rods with rounded or rectangular ends and varying



THE DIFFERENT TYPES OF COCCI
"Streptococci" form chains when they multiply; "staphylococci" divide irregularly and form bunches; "diplococci" remain in pairs, and the cubical masses are termed "sarcinæ."

greatly in length. As a rule they are motile and many possess flagella—delicate protoplasmic threads which vibrate to and fro. The SPIRILLI are curved or spiral filaments. They are divided into the "comma" bacilli or vibrios, and the spirochætes. The latter type is distinguished by its length and flexibility: its motility is caused by an undulating or screw-like contraction of the protoplasm.

The HIGHER BACTERIA consist of branching filaments made up of simple elements such as occur in the lower forms. They are often ensheathed and the component filaments are interdependent. Growth may occur at one end while the other serves to attach the organism to some object. In certain of the highest types, special elements are set apart for the particular function of reproduction.



HOW BACTERIA MULTIPLY
The lower forms reproduce simply by dividing in two, while many of the higher forms shed spores which have developed within the parent organism.

Reproduction.

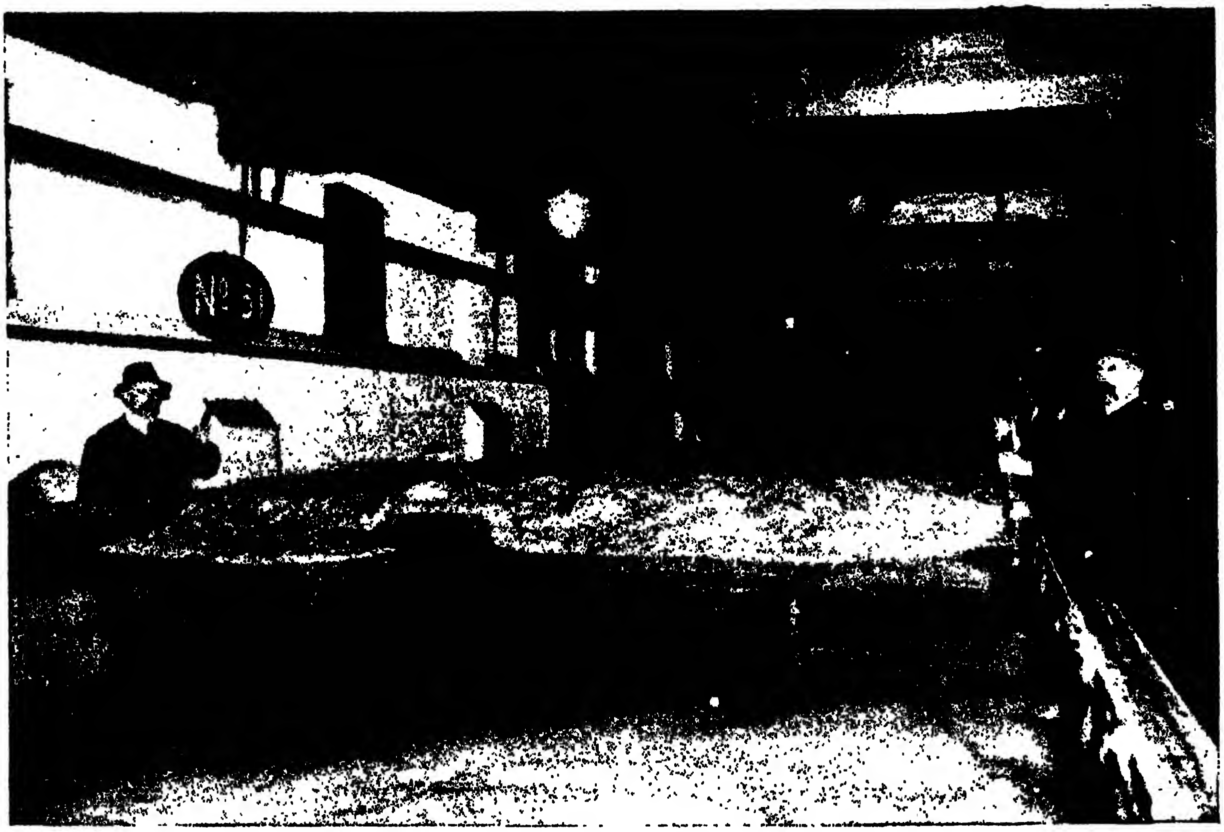
Bacteria under favourable conditions multiply rapidly. Reproduction takes place by simple "fission" or by "spore formation. Fission is a process of transverse division whereby the protoplasm divides into two equal parts, each of which lives on and divides in its turn. Spore formation represents a resting stage of the organism and serves to perpetuate the species when it is threatened with extinction from adverse circumstances, *e.g.* presence of oxygen or lack of proper food. A minute granule appears within the protoplasm. It enlarges; becomes enveloped in a thin but resistive membrane, and lies within the mother cell—a potential new organism. Spores are highly resistant to the influence of temperature and noxious chemical agents, and may remain vital for months or even years. In a suitable medium the spore "germinates"; it swells, elongates, bursts forth from the capsule and assumes the original bacillary form. The higher bacteria such as moulds reproduce by special filaments which form hundreds of spores; yeasts give off little buds which in time produce new chains of fungus.

Bacterial Growth.

Bacteria, like all living organisms, require suitable nutritive substances and certain environmental conditions in order that they may exist and multiply. Carbon, hydrogen and nitrogen are the main nutritive elements, and these are derived from carbohydrates and proteins. Hence bacteria are chiefly found living on the complex organic material which forms the bodies of dead plants and animals. One species can directly utilise the atmospheric nitrogen—a matter of extreme importance in agriculture. Free oxygen is necessary for the growth of certain bacteria; they are then known as "aerobic." Some cannot develop in the presence of this gas and are termed "anærobic." Others can grow either in the presence or absence of oxygen but with a preference either one way or the other and are described as "facultative anærobic."

Water is absolutely essential for the growth of bacteria. Drying impairs their vitality and may actually kill them. Resistance to this varies with the species. The anthrax bacillus, which retains its virulence after years of dessication, is much more resistant than the spirillum of cholera which is incapable of development after two or three hours of drying.

Temperature is an important factor in the life of bacteria. Though there is a fair range



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THE IMPORTANCE OF BACTERIA IN INDUSTRY.

Beer fermenting in a brewery—a process in which the natural activity of bacteria is turned to man's use.

within which they can exist, there is an optimum at which growth is most luxuriant. The normal inhabitants of the human body and those organisms which produce disease thrive best at blood heat (37°C.). Unnatural temperatures cause them to lose some of their properties. Exposure to intense cold paralyses bacterial life but does not destroy it; a suitable temperature causes the spores to germinate and the bacilli are rapidly restored to normal activity. Exposure to a sufficiently high temperature for a sufficient period kills bacteria. Moist heat is more efficient than dry heat. The application of steam under pressure for fifteen minutes suffices to kill all known organisms.

Most bacteria develop best in the dark. Sunlight and, to a less degree, electric light, are injurious to bacterial existence. Exposure to direct sunlight for a few hours kills most bacteria—notably those of plague and tuberculosis. The effect of sunlight is enhanced by dryness. The ultra-violet rays, through the medium of the Finsen lamp, are utilised to cure lupus vulgaris, a tubercular inflammation of the skin. Unfortunately the action of sunlight is superficial; the rays have comparatively little power of penetration. X-rays and radium emanations have little effect in checking bacterial growth.

According to their mode of life bacteria are divided into two classes. When the organisms derive their nourishment from a living animal or plant—the "host," they are known as "parasites." If they obtain nourishment from dead organic matter, they are termed "saprophytes." Certain saprophytes play an important and useful part in everyday life. They are the putrefactive agents which transform dead and decaying matters into their component elements and render them available for vital assimilation thus completing the cycle of life.

As already indicated, the chief effect of bacterial growth is to disintegrate or reduce to simple elements the complex organic

matter which forms the bodies of animals and plants.

In putrefaction, proteins are split up in a manner analogous to the digestion of proteins in the gastro-intestinal tract. In fermentation, carbohydrates are reduced with the production of alcohols, ethers and acids, *e.g.*, the ordinary fermentation of sugar by yeast. The mode of bacterial action in both processes appears to be dependent on the formation of "ferments" which may be set free in the surrounding fluid or may be retained within the bacterial cell.

Gas formation is a common accompaniment of bacterial action. The evil-smelling gases in the intestine and marsh gas are produced in this way.

Alteration in the medium in which bacteria develop, most frequently towards an acid reaction, is another common result of bacterial activity. The souring of milk, the becoming rancid of butter, and the preparation of vinegar exemplify this. Bacteria are also responsible for the production of many brilliant pigments.

In the human alimentary canal, bacilli are present from a few days after birth until the end of life and they play a useful and necessary part in digestion, though under certain circumstances they may exercise harmful effects.

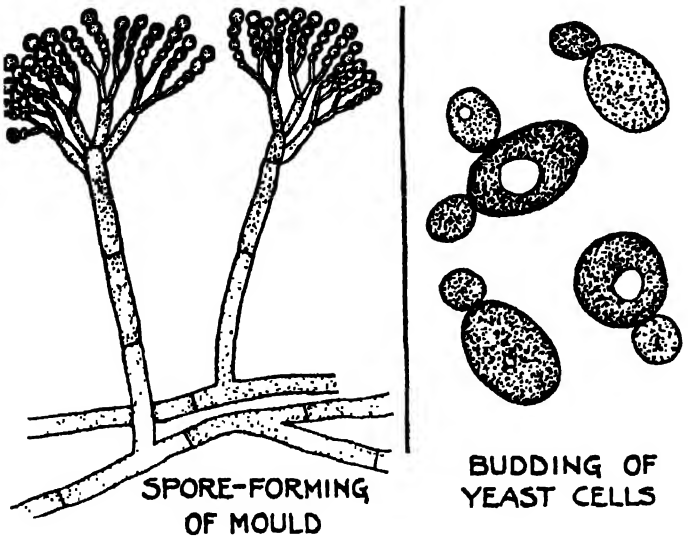
Many substances are produced by bacteria, the exact nature and composition of which are unknown; these include poisonous bodies—"toxins" which are so significant in the causation of disease.

In relation to bacterial activity it is a notable fact that most bacteria produce substances which eventually inhibit their growth and functioning. Thus alcohol, vinegar, and the gases resulting from the activity of the intestinal bacilli check the excessive growth and finally exterminate their respective bacteria. It is believed that the sudden crisis and subsequent recovery in certain infectious diseases, such as pneumonia, is occasioned in this manner. The

[*Keystone*

BACTERIA AND FOOD

A scene in the laboratory of Messrs. J. Lyons & Co., where the bacteriological activity in food is investigated.



HOW MOULDS AND YEASTS REPRODUCE
Moulds possess special filaments in which spores are formed; yeasts give off little buds which in time produce new chains of organisms—both are higher forms of bacteria.

infective organisms are killed by the poisons they themselves have generated.

RELATION OF BACTERIA TO DISEASE

Owing to the power of bacteria to exist and multiply in living tissues and to produce as a result of the vital activities certain chemical substances inimicable to cellular life, animals, including man, are subject to so-called "bacterial diseases." The disease process is revealed at the site of invasion by local tissue changes; at a distance, following the absorption and diffusion of bacterial products or toxins, by cellular degenerations; generally, by evidence of mal-nutrition from alterations in the vital processes.

Complete proof that a specific organism is the direct cause of a certain disease necessitates the fulfilment of three conditions; the organism must always be present in the body or its discharges whenever the disease is present; the organism must be capable of being isolated and cultivated outside the body; inoculation of a healthy animal with the pure culture thus obtained must be followed by symptoms of the original disease.

Diseases caused by bacteria are regarded as "infective" and the chief methods of Spread of Infection are :—

(1) Inoculation through wounded or unwounded surfaces of the skin or mucous membranes: *e.g.* syphilis.
(2) The swallowing of organisms in food, water, or dust—intestinal infection; *e.g.* typhoid fever.
(3) The inspiration of bacteria or their spores—pulmonary infection; *e.g.* tuberculosis.
(4) Inoculation through the agency of some biting insect such as the mosquito; *e.g.* malaria.

Two important modifying factors must be considered in relation to bacterial disease.

(1) The infective agent. Bacteria vary greatly in virulence. A streptococcus which causes a slight local inflammation may cause a fatal septicæmia when its virulence is raised. The number of organisms introduced and their portal of entry are influential factors. There is a natural limit to the number of invading organisms which healthy tissues can resist and direct invasion of the blood-stream is more dangerous than a local infection.

(2) The subject of infection. Normal individuals vary widely in their susceptibility and resistance to infection. Race, age and personal idiosyncrasy are important determinants. Increased susceptibility may be caused by exposure to extremes of temperature; hunger, thirst. excessive fatigue; and debility from other disease. A notable example of diminished resistance to organismal infection is seen in the case of diabetes; severe forms of tuberculosis and skin inflammations are very apt to complicate this disease. Certain individuals may possess an absolute resistance to specific infections. They are regarded as possessing a "natural immunity." Several diseases, notably smallpox, measles and scarlet fever do not tend to recur in persons who have previously suffered from them even though they are again exposed to infection. The first attack

is protective and an "acquired immunity" to a specific disease has been gained. In contrast to this, attacks of certain diseases, especially pneumonia, influenza, erysipelas and diphtheria, predispose to recurrent attacks of the same disease. It is interesting to note that the lower animals are naturally immune to certain important diseases—*e.g.* syphilis, leprosy, gonorrhœa, cholera and typhoid—to which man is susceptible.

Attack and Defence.

Certain tissue changes are produced at the local site of a bacterial invasion. They are of a dual nature; destructive or degenerative on the part of the bacteria—defensive or reparative on the part of the tissues. Together they constitute the "inflammatory reaction."

In the process of inflammation there is a preliminary flooding of the invaded tissues with blood. Later a stasis or local stagnation follows. The white blood cells adhere to the capillary walls and gradually push their way in great numbers into the tissue spaces. At the same time there is an exudation of lymph from the blood. The white corpuscles aided by the fixed tissue cells endeavour to ingest and destroy the invading organisms. This constitutes "phagocytosis," one of the body's main defences against bacterial disease. Should the phagocytic cells overcome the invaders, resolution takes place; the white cells return to the circulation and repair of any damage is effected by the activities of the cells of the surrounding tissues. Should the bacteria destroy the phagocytes (either as a result of the virulence of their poisons or the feeble powers of the protective cells) there is destruction or "necrosis" of tissue; the bacteria flourish and pus formation results.

The local tissue changes at the site of the bacterial invasion may be relatively of little significance compared with the general effects which are produced by the toxins elaborated there and absorbed into the circulation. An intoxication, analogous to drug-poisoning, results and the highly developed secretory cells of organs such as the kidneys and liver are apt to suffer. They undergo a change known as "cloudy swelling" which, in severe intoxications, may be followed by fatty degeneration or actual disintegration of the cells. It should be noted also that certain toxins have a selective affinity for certain tissues, *e.g.* the diphtheritic and tetanic poisons specially select and attack the nervous system.

Another effect of the circulation of bacterial toxins, *i.e.* toxæmia, is a disturbance of metabolism. The processes of digestion, absorption, and assimilation of food, and of excretion of waste products are upset and consequently the general level of organic functioning is lowered. Malnutrition and a degree of wasting are inevitable.

An important feature of toxæmia is interference with the process of heat regulation resulting in "fever." This varies in degree and course, sometimes conforming to a definite type when the bacteria are selective in their field of attack as in typhoid, sometimes of a very irregular nature when the bacteria from time to time invade fresh areas of the body as in suppurative affections.

THE BLOOD'S DEFENCE AGAINST BACTERIA

White blood cells or phagocytes devouring and destroying disease germs which have entered the body.

The actual cause of the development of fever is obscure; it may result directly from the action of the bacterial poisons on the heat-regulating centre in the brain; the modern tendency is to regard it as a protective response on the part of the body against the invading organisms.

Toxins are poisonous bodies produced by the vital action of bacteria within the animal body or in artificial media. They are regarded as specific products of the vital activities of the bacterial cell, thus differing from ptomaines which originate from the disintegration of matter subsequent to bacterial action.

Toxins and Antitoxins.

Toxins may be retained within the bacterial cell remaining an integral part of it (endotoxins or intra-cellular toxins), or, after their formation in the cell, they may be secreted into the surrounding medium (extra-cellular toxins). The diphtheria and tetanus bacilli are the best examples of organisms which produce an extra-cellular toxin. When a culture of these organisms is filtered through a porcelain filter, toxic fluids are obtained, which on injection into animals exactly reproduce signs of the corresponding diseases. In contrast, the bacilli of tuberculosis, typhoid, anthrax and cholera produce endotoxins which cannot be separated by filtration or other method from the protoplasm of the bacterial cells.

Comparatively little is known about the intimate chemical nature of toxins. The extra-cellular variety are allied in constitution and character to proteins. They are uncrystallisable, soluble in water, and relatively unstable. Their toxicity is diminished or destroyed by heat, light and chemical agents. Regarding the toxins intimately associated with the bacterial protoplasm there is little definite known but they are believed to be similar in chemical nature to the extra-cellular toxins.

By repeated injection in animals of small and weakened, but gradually increasing, doses of a specific toxin, a state of gradually increasing resistance to the toxin is acquired. The blood is stimulated to produce a neutralising body—an antitoxin—the physiological antidote to the toxin. According to the antecedent injections, these bodies are proportionately increased and the blood-serum of these animals when withdrawn can be used to confer antitoxic powers upon other animals or human beings.

Serums are now prepared, by the gradual and prolonged immunisation of some animal—usually the horse, for protection against various diseases and also for their cure. Chief among these are the anti-diphtheritic and anti-tetanic serums.

(For other protective responses of the blood to organismal infection, see the section on The Blood.)

BACTERIOLOGY OF SOME IMPORTANT DISEASES

A large number of organisms give rise to the formation of pus; these include staphylococci, streptococci, pneumococci, gonococci, meningococci, the bacilli of tuberculosis and typhoid, and the common bacilli of the intestine.

Acute Inflammations.

Staphylococci and Streptococci are the most frequent causes of localised inflammations. Skin suppurations such as pustules, boils, carbuncles and impetigo, catarrhs of mucous membranes, inflammations of the bone marrow and abscesses are commonly a result of staphylococcal infections. Deep-seated, spreading and grave inflammations such as erysipelas, puerperal uterine sepsis, ulcerative endocarditis, and septicæmia are generally associated with streptococcal infections. Streptococci vary greatly in virulence. A special variety, the diplococcus rheumaticus, is regarded as the causal factor in the joint and heart valve inflammations which occur in rheumatic fever.

The Gonococcus produces an acute inflammation of the human urethra accompanied by the discharge of infective pus. Gonococci are small organisms, coffee-bean shaped and commonly grouped in pairs. They are usually found within the pus cells and are often referred to as the "intracellular diplococcus." Gonorrheal infection may originate as a venereal disease or may be innocently acquired from contact with infected towels,

Courtesy] [*Central Council for Health Education*

THE OUTWARD SIGNS OF BACTERIAL INVASION
A diseased cow, showing emaciation due to severe tubercular infection.

etc. In the new-born, a serious inflammation of the eyes may be caused by infection from maternal discharges. Gonococci may cause inflammation in any part of the genito-urinary tract, in the joints and in the heart valves.

The Meningococcus is the causal organism in Epidemic Cerebrospinal Meningitis ("SPOTTED FEVER"). It resembles the gonococcus in appearance and arrangement. The meningococcus gains entrance to the body by way of the nasal passages; it is frequently found in persons who do not suffer from the disease but who are responsible for spreading it (carriers). The meningococcus can usually be found in the cerebrospinal fluid of infected persons. In the treatment of this disease a curative serum has been used with some success.

The Pneumococcus is the organism most commonly found in cases of ACUTE LOBAR PNEUMONIA. The cocci are oval-shaped, found in pairs, and are surrounded by well-defined capsules. Their virulence is subject to great variation and they are often found in the healthy mouth. The pneumococcus is a pus-forming organism and may be the causal factor in broncho-pneumonia, pleurisy, endocarditis, pericarditis, peritonitis, meningitis, and arthritis. In acute pneumonia, the pneumococcus may be associated with other causal organisms, viz., the pneumo-bacillus, the influenza bacillus, and a streptococcus.

TUBERCULOSIS is one of the most widely spread of all diseases in man and animals. It is caused by the tubercle bacillus—a minute, non-motile, slender rod. Two chief types of bacilli are recognised: the human—which is the common cause of tuberculosis in man, and the bovine—which produces tuberculosis both in cattle and in man.

Tubercle bacilli have considerable powers of resistance and can retain their vitality outside the body for prolonged periods. Dried phthisical sputum has been found to contain virulent organisms after two months. Exposure to a moist heat of 70°C. for some time (thirty minutes) is fatal to them, and this method is used in sterilising milk (pasteurisation). Infection takes place through the inhalation of tubercle laden dust or droplets of saliva ; from the ingestion of tubercular milk or meat ; or by direct inoculation of the skin. Pulmonary tuberculosis (phthisis) is nearly always caused by the human type of bacillus : abdominal tuberculosis and tuberculosis of bones and joints (common in children) is attributed in at least half the cases to the bovine type derived from infected milk. Scarcely any tissue or organ in the human frame is immune to tubercle infection. Although tuberculosis is best known as a lung disease, the glands, bones, joints, skin, peritoneum, urinary organs and brain membranes are frequently attacked.

Syphilis is caused by an organism known as the Spirochæta Pallida or Treponema Pallidum. It is a delicate, thread-like spirillum, actively motile and readily destroyed by heat or absence of moisture. The spirochæte has been demonstrated in every form of syphilitic lesion, including the brain in general paralysis and in the organs of children suffering from inherited syphilis. Syphilitic infection may be acquired venereally or may arise innocently from contact by kissing, or through the medium of articles contaminated by a syphilitic person.

Anthrax is a comparatively rare disease caused by the anthrax bacillus and communicated to man by certain animals such as sheep, oxen or horses. The organism is relatively large and produces spores which have a high degree of resistance. They remain alive for years, and can survive boiling for five minutes. In man the disease is transmitted by means of spores or bacilli through an abrasion of the skin or by inhalation from handling infected hides, wools, furs, and fleeces. The disease may appear as a malignant pustule, as acute pneumonia or as a serious form of blood-poisoning (anthracæmia). An anti-anthrax serum is used in treatment.

Tetanus or Lockjaw is produced by the tetanus bacillus—a rod-shaped organism with a single spore at one end, giving it the appearance of a drum-stick. The bacilli are widely distributed in nature and are commonly found in soils which have been well manured. The spores, like those of anthrax, are highly resistant. Infection results from wound contamination, and the symptoms are due to the toxins produced in the wound acting on the nervous system. A standardised anti-tetanic serum is used very successfully as a preventative in wound infections ; in actual treatment it is of less value, for the disease is only recognised when considerable absorption of toxins has occurred.

Diphtheria is caused by the Klebs-Löffler bacillus—a slender, non-motile, non-sporulating organism with rounded ends. The virulence of the bacillus varies considerably ; it may be found in the throats of healthy persons, but in the susceptible it produces a surface inflammation. The bacilli flourish and produce their toxin, which on absorption poisons the heart, nerves and kidneys. The disease may be acquired by direct infection or may be contracted through the agency of infected milk. Early injection of diphtheritic antitoxin is speedily followed by a reduction in the severity of the symptoms.

Typhoid Fever and the diseases allied to it, Para-typhoid A and B, Bacillary Dysentery and bacterial forms of meat poisoning are caused by a number of organisms—the colon-typhoid group—which resemble each other considerably in their general appearance, mode of growth, cultural habits, and, roughly, in their effects upon the intestine and upon the body as a whole. The typhoid bacillus is thick, rod-shaped, non-sporulating, flagellated, and actively motile. Infection is commonly acquired by the ingestion of contaminated water, shell-fish, vegetables, or milk. Typhoid " carriers " occur and the handling of food by such persons is a great source of danger. A vaccine of typhoid

bacilli is used as a preventive and a curative measure.

CHOLERA is caused by an S-shaped spirillum, actively motile with a single flagellum at one end. It does not form spores. The organism is readily destroyed by drying or by sunlight. Transmission of the disease may take place by means of infected water, milk, uncooked vegetables, or soiled clothing. A preventive vaccine has been prepared.

MALARIAL FEVERS are caused by a group of parasites which are conveyed from man to man by a special genus of mosquito. Other diseases caused by animal parasites include Amoebic Dysentery, Sleeping-Sickness and Kala-Azar.

There are a number of diseases, such as smallpox and measles, which bear a close resemblance to bacterial diseases but which have not been definitely proved to be of organismal origin. In other diseases, such as infantile paralysis and hydrophobia, the causal organisms cannot be seen by the microscope and are apparently able to pass through a porcelain filter - yet they may be cultivated and when inoculated into animals, reproduce the original disease. With the advancement of bacteriology there is little doubt that the specific organisms responsible for such diseases will eventually be isolated and identified.

In conclusion, an accurate knowledge of the nature, life, and activities of micro-organisms is essential to the understanding of disease. Though bacterial infection is not the sole factor in the production of disease it stands in intimate causal relationship. Bacteriology has contributed greatly to the science of pathology and to the advancement of preventive medicine.

A DRAMATIC CHAPTER IN PASTEUR'S LIFE

By the Secretariat of the League of Red Cross Societies.

PASTEUR's life was one of patient study, and his victories over disease were unostentatiously won in the drab atmosphere of the laboratory, with no flare of trumpets. But there was an element of the dramatic in the following incident, which was an important milestone in his career.

In France and elsewhere, a disease known as anthrax, or wool-sorters' disease, was causing havoc among cattle and sheep, and claiming not a few victims among human beings. The French peasants were losing millions of francs every year from its ravages, which no one had hitherto been able to control. Its very cause was unknown. Pasteur found that it was caused by a germ. He noticed that its virulence could be reduced if it was cultivated for several days at a temperature somewhat higher than that which suited it best. By thus gradually reducing the virulence of anthrax germs, he rendered them innocuous to various animals fatally susceptible to normally virulent germs. By injecting cultures of the germs, whose virulence had been reduced, into certain animals, he not only did not kill them, but he rendered them immune to a subsequent injection of ordinarily virulent germs.

Here, then, the way lay open to a crushing victory over this disease. But at this period, 1881, Pasteur's authority was far from being universally accepted. His report to the French Academy of Sciences was received with scepticism and even active opposition. Among his opponents was a veterinary surgeon, who challenged him to submit his theories to a public test conducted on a large scale. The challenge was accepted: forty-eight sheep, two goats, and ten head of cattle were selected for the experiment, which was conducted on a farm at Melun in the centre of France. It was arranged that twenty-four sheep, a goat and six cows were to be inoculated with the anthrax germ whose virulence had been artificially reduced. Pasteur foretold that all these animals would survive not only this injection, but also a subsequent injection of normally virulent germs, whereas the animals, not protected by a preliminary injection of weakened or attenuated germs, would succumb to an injection of virulent germs.

Pasteur's claims were considered extravagant, and he and his assistants were subjected

From the painting] [*By Edelfelt*

THE DISCOVERER OF BACTERIAL ACTION
Louis Pasteur at work in his laboratory.

On the morning of June 2, a large crowd assembled at the farm. It was an anxious time. Pasteur was certain of his laboratory observations, but in the world outside the laboratory many unexpected things may happen. His mind had, however, been relieved on the previous evening by a telegram of assurance. He reached the farm at two o'clock in the afternoon, and there he saw laid out the carcasses of twenty-one of the twenty-four sheep which had not been protected by the attenuated germs, and of the one unprotected goat. The twenty-four

The Crucial Test.

to much ridicule when they arrived at the farm, where a large crowd of farmers, veterinary surgeons, journalists and others had collected. Little wonder that the crowd scoffed, for what Pasteur claimed he could do was nothing short of a miracle. The scene must have been reminiscent of that depicted in the Old Testament when Elijah took part in a pyrotechnic competition with the prophets of Baal. Pasteur's life may not have been at stake, but his reputation certainly was. On May 31, the final and crucial test was carried out. Both the animals which had received injections of the attenuated germs, and the animals which had hitherto been untreated, were given injections of virulent anthrax germs.

sheep and the goat protected by the attenuated germs appeared to be in good health. On the evening of the same day, the three remaining unprotected sheep were dead. The six cattle protected by the attenuated germs were not a whit the worse for the injection of virulent germs, whereas the four unprotected cattle showed extensive swellings at the site of the injection, and were feverish.

Pasteur's return from the farm to the railway station of Melun was marked by scenes of the wildest enthusiasm. The sceptics, who had come to hoot, stayed to cheer, and as the enthusiastic crowd surged round him, Pasteur must have wondered whether the risks of being a true prophet were not almost as great as those of being

a false one. His laboratory tests, necessarily conducted on a small scale, were now confirmed by a wholesale test conducted under the most exacting conditions. Before the Agricultural Society of Melun had invited Pasteur to submit his theories to a mass test, they had been theories only. Henceforth they were to be accepted as laws. The publicity which was to have blighted Pasteur as an idle boaster, brought him sudden world-wide fame, and the twenty-four sheep stretched out dead on the farm of Monsieur Rossignol contributed not a little to saving the lives of thousands of sheep and cattle which, shortly after this experiment, were given injections of the attenuated anthrax germs.

But it was not only the lives of countless animals that Pasteur saved. The results of his experiments with anthrax were soon applied to hydrophobia and various other diseases with striking success. The comparative immunity which civilised communities now enjoy from such scourges as typhoid fever may be traced in part to Pasteur. May we never forget what we owe him!

ANIMAL PARASITES OF THE HUMAN BODY

By J. H. BARNARD, O.B.E., M.D., late Physician to the Victoria Home, Paris.

WORMS

WORMS are of three kinds: flatworms, roundworms, and segmented worms. Of the Flatworms, two classes provide human parasites, viz., the flukes and the tapeworms. Of the Roundworms, the hookworms, pinworms, the intestinal roundworm (*Ascaris*), the trichina worm, the filaria, and the guinea-worm are human parasites. Of the Segmented Worms, only the leech interests us.

Of the Flukes, four groups infect human beings, viz., blood flukes, lung flukes, liver flukes and intestinal flukes.

Flukes.

BLOOD FLUKES are common in the countries bordering the eastern end of the Mediterranean, South-Western Asia, and parts of Africa.

These flukes are half an inch in length, and are often found in hundreds in the abdominal veins of their host. Their oval eggs carry a stout spine at one end. These eggs are carried to the small vessels on the surface of the bladder, which they penetrate by means of the spine. They are passed in the urine, which contains blood. Sometimes they ascend to the kidneys. They damage the host by blocking the veins, by the bleeding and inflammation of the bladder and by excreting toxins into the blood which cause weakness and anæmia.

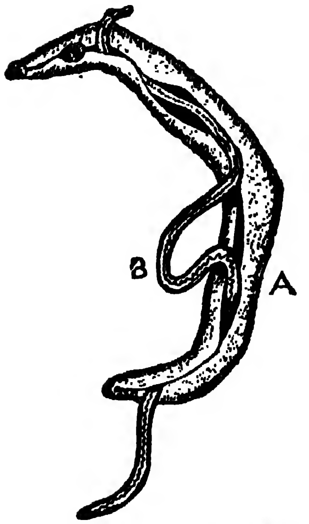
Infection occurs either by drinking water or by bathing. The parasite leaves its temporary host—a water snail—and swims about waiting for a human host, a monkey or rodent. The symptoms develop in from two to four months after infection.

In treatment, rapid improvement follows the injection every other day into the veins of a solution of tartar emetic (tartarated antimony), which has a specific action on the worms and their eggs. The treatment is continued until the voided eggs are sterile, the total quantity of the drug required being twenty or thirty grains.

Prevention necessitates the protection of the drinking water from infected urine. Even this can be dispensed with if the drinking water be impounded in protected reservoirs for forty-eight hours, all the parasites being dead at the end of that interval.

LUNG FLUKES are a very common source of lung disease in China, Japan, the Philippines, and in Formosa. This fluke, half an inch long, after spending part of its existence in crabs which are consumed by the natives as food, settles in the eater's lungs, where it produces cavities and causes blood-spitting, the expectoration containing, in addition to blood, the eggs of the fluke. Occasionally, this fluke burrows into muscles, the liver, intestine, or the brain. In the latter case, epileptic fits occur, usually followed by death.

LIVER FLUKES are common in the countries above named, the commonest being the



[After Looss

BLOOD FLUKES

A flatworm type of human parasite found in the East. (A) male; (B) female; (6½ times natural size).

Chinese flukes contained in freshwater fish, the intermediate host, which is extensively consumed uncooked.

These flukes settle mostly in the gall-bladder and bile ducts. The liver enlarges and there is bloody diarrhœa, and, frequently, jaundice. Anæmia and intense debility result, the patient often falling a victim to a trivial cold or to an attack of malaria. Tartar emetic is an effective remedy.

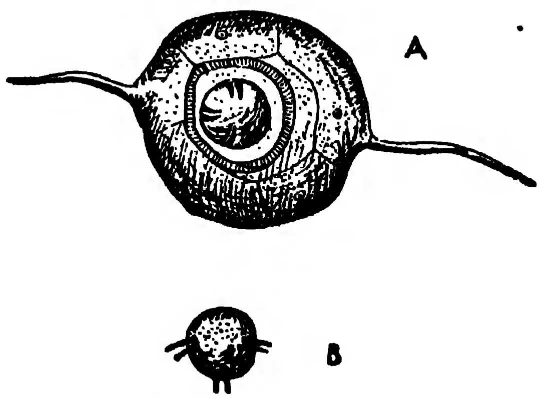
INTESTINAL FLUKES in several species are common in the above-mentioned countries. They cause anæmia, wasting and general weakness. Diarrhœa is a common symptom. Snails are generally the intermediate hosts, infection resulting from eating raw water-plants.

There are three kinds of Tapeworm, viz.: tænia solium, tænia saginata, and bothriocephalus latus.

Tape-Worms.

The TÆNIA SOLIUM (PORK TAPE-WORM) is a flat, ribbon-shaped worm, very narrow at one end and broader at the other, ten to twelve feet in length and made up of small segments, sometimes many hundreds in number, to form a chain. Each segment is an individual, possessing complete reproductive systems of both sexes. Lying as they do in the small intestine, bathed in semi-digested fluids, these segments possess no digestive organs. The "head" (scolex) is at the narrow extremity (really the posterior end of the chain) and is as large as a pin's head. It presents a central prominence or proboscis surrounded by a row of twenty-six small hooks; at the sides are four suckers. By these it attaches itself to the intestinal wall. After the head comes a narrow neck, the segments of which are very small and thin. As the other extremity is approached the segments become gradually larger and broader and acquire a sexual character. Each one has male and female organs, the apertures of which are on one edge of each segment, alternately on one side or the other of the worm. The oval eggs are microscopic in size and have a thick shell. The segmented chain lies coiled along the bowel as far as the lower end of the small intestine (the ileum). When the lower segments are ripe, they are detached and are expelled with the stools in defæcation. The eggs become free and are scattered on the ground, on grass or on leaves.

The further development of the egg requires it to be swallowed by an animal. The pig does this for this kind of tapeworm, taking in the egg with vegetables or the refuse it consumes. In the pig's stomach the eggshell is dissolved by the gastric juice, and the embryo (the fertilised germ) provided with six hooks, bores its way into the stomach or the blood-vessels of the bowel,



TAPEWORM EMBRYOS

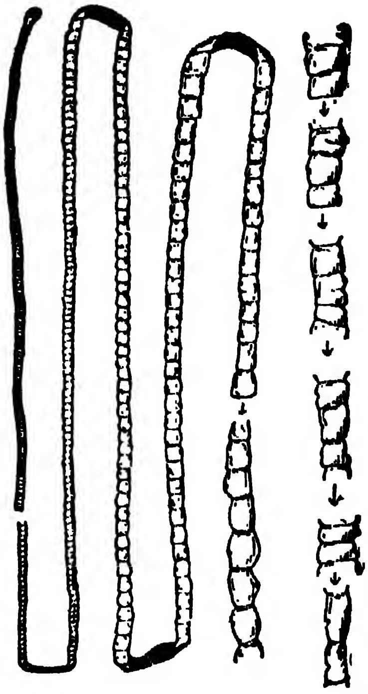
(A) a tapeworm embryo within the egg; (B) a freed embryo (500 times natural size).

and is thus carried to the liver, muscles, or other parts of the body. Around it is developed a bladder about the size of a pea. If these cysts or bladders be in the pig's muscles, the pork is said to be measly, and, eaten by man, gives rise to the infection.

The **Tænia Saginata (Beef Tapeworm)** is the tapeworm most commonly met with in England. It differs from the pork tapeworm in that its head, though provided with four suckers, has neither proboscis nor hooklets. This worm may attain a length of fifteen or eighteen feet, and the segments may number 1200 or 1300, the last 150 or 200 being ripe. The eggs have the same shape as those of the pork tapeworm, but are a little larger. The bladders (cysts) above-mentioned are found, not in pork, but in beef or veal.

Symptoms may be absent, and the presence of the worm only discovered by the passing of the segments in the stools. Colic may be complained of, or the appetite may be voracious. Occasionally, headache, mental confusion, depression, or even "fits" may supervene, these nervous symptoms being due to the toxins liberated by the worm.

The usual remedy prescribed is *oil of male fern* administered early in the morning before breakfast after a fast dating from 6 p.m. the previous evening. Four hours after the dose, castor oil is given and the motions are passed into warm water. The



After Stiles

THE BEEF TAPEWORM

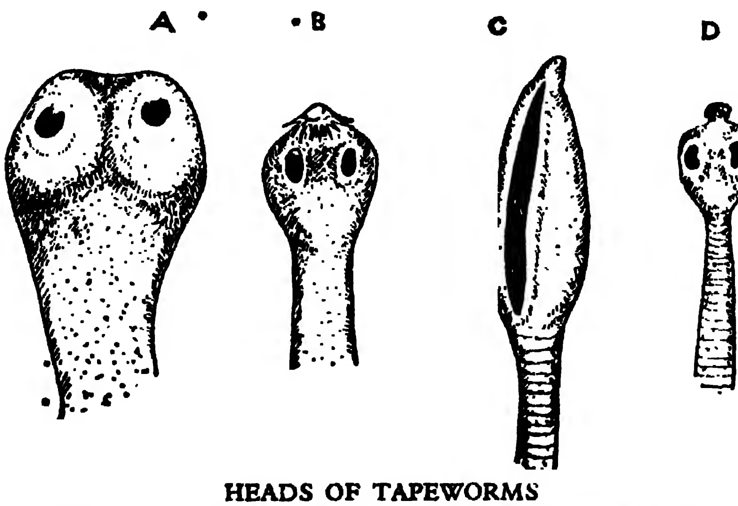
The commonest British tapeworm, which may be as much as 18 feet in length.

head must be sought, for unless it be passed, the segments will grow again. If the head be not found, it will be three months before segments are again passed. It is, therefore, better to wait till fresh segments are voided before repeating the treatment. The head is so small that it may easily elude discovery.

One caution is necessary. The castor oil should never be taken simultaneously with the male fern, as it dissolves a noxious ingredient in the latter. For a similar reason, alkalies such as bicarbonate of sodium or Vichy water should be avoided.

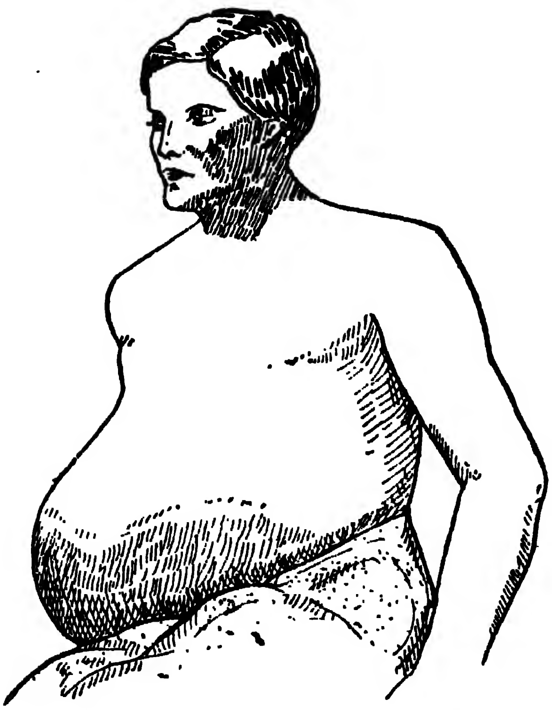
Other remedies are Kousso, oil of turpentine, and decoction of pomegranate root bark.

Bothriocephalus Latus is especially found in Switzerland and Central Europe. It is much larger and longer than the preceding, its length being from seventeen to twenty-six feet. Its head is elongated and is provided with only two



HEADS OF TAPEWORMS

Heads of (A) beef; (B) pork; (C) fish; and (D) dog tapeworms (15 times natural size).



[After Huber

A CASE OF HYDATID CYST

A man with enormously enlarged liver due to the multiple hydatid cysts of the larval form of a dog tapeworm.

suckers. The segments number about 3000. The eggs are developed in fresh water and form embryos which have six hooklets and whip-like processes (cilia) which enable them to swim. Swallowed by fishes, especially pike, they penetrate to their organs and muscles, where they form cysts. Man is infected by eating the fish.

There is always serious anæmia from the absorption of toxins excreted by the worm, these toxins having the power of dissolving the red blood corpuscles and acting injuriously on bone marrow.

The same treatment holds as for the pork and beef tapeworms.

Other kinds of tapeworm are found, though rarely in man. Of these, only one need be mentioned, viz., the Dog Tapeworm. This worm is abundant in dogs, and sometimes in cats, all over the world. About one foot in length, its eggs are swallowed by the larvæ of dog-fleas. Children who play with dogs are occasionally infested by this worm, probably by swallowing fleas or by crushing them and then putting infected fingers into the mouth.

Larval Tapeworms inhabit the human body in the bladderworm (larval) stage. Of the three types found in man, the most important are the huge multiple cysts (Hydatids) of a small tapeworm of dogs (*Echinococcus Granulosus*). The bladderworms of the pork tapeworm may also occur in large numbers and in important organs.

The echinococcus hydatids are very common in some parts of the world, especially in children. In Iceland, where dogs and people live together, two or three or even ten per cent. of the inhabitants are affected. In Australia this is also the case. The adult of echinococcus is a very small tapeworm (one-tenth to one-fifth of an inch) of the dog. Hundreds or even thousands may inhabit the dog's intestines. The eggs, dropped in pastures, are swallowed by sheep or cattle. Children become infected by being licked by dogs.

The hydatids develop in the liver (a favourite site), lungs, kidneys, spleen, intestinal walls, heart, brain and muscles in the above order of frequency. The bladders grow slowly and in time may form a very large swelling filled with watery fluid which is liable to burst.

The preventive measures are: avoid familiarity with dogs, exclude these animals from drinking water, and prevent them from eating entrails of animals infected with hydatids.

The bladder worms of the pork tapeworm develop from the six-hooked embryos freed from the eggshell by the gastric juice. The embryos bore through the intestines and migrate to various organs and tissues to develop. The presence of a few of them in the muscles or under the skin is of no importance, but if they are located in the eye, heart, spinal cord, or brain, it becomes a serious matter.

Because of the possibility of self-infection with the eggs, the pork tapeworm is the most dangerous form that can be harboured by man.

In prevention, measly pork can be

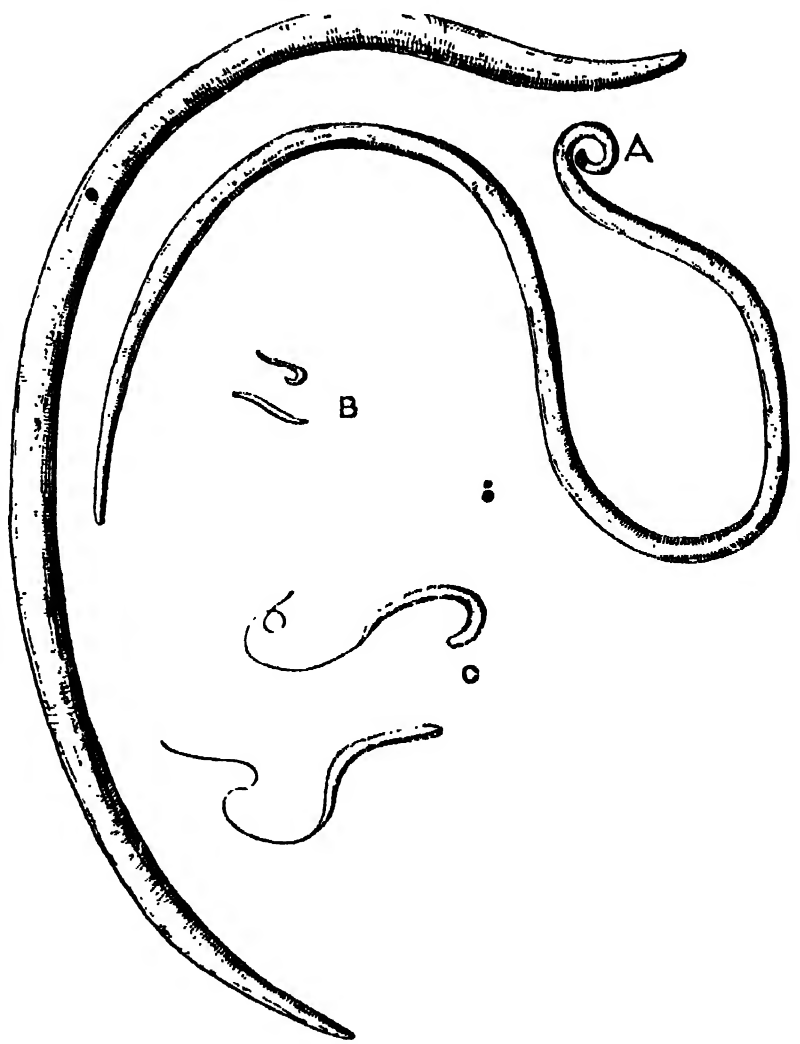
rendered quite harmless by heating to a temperature of 127° F., and beef bladderworm by heating to 120° F. The difficulty is to get the centre of a joint up to this temperature. Thus, a ham cooked for two hours was found to have reached, in its centre, a temperature of only 115° F. When pork is roasted, it should be cut into pieces of three or four pounds in weight. Beef which has lost its red colour after cooking is quite safe. Ordinary cold storage—for three weeks in the case of beef, a little longer for pork—and thorough curing and salting kill the parasites.

Roundworms.

In Europe, infection by HOOKWORMS goes by the name of tunnel disease and miner's itch; in Egypt, chlorosis; in Colombia, tuntun. It is very common in Africa and in parts of Asia, especially Ceylon. In the United States it is very prevalent in the southern states, and is a serious problem in Cuba, Porto Rico and Brazil. In Europe, an allied species, the *Ankylostoma duodenale*, is the most prevalent.

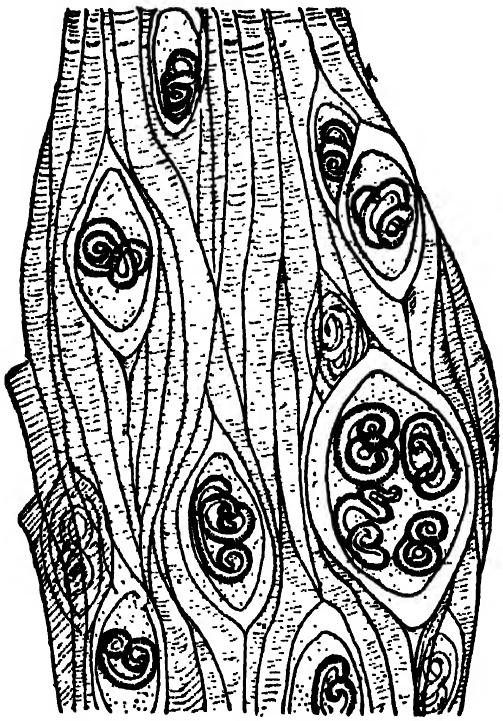
This ankylostoma is a small roundworm which inhabits, in great numbers, the duodenum and jejunum (the first and second parts of the small intestine). This disease, of which intense anæmia is the principal symptom, occurs in many countries. In Egypt it is called, as already said, "Egyptian chlorosis." It is frequent in Italy amongst workers in furnaces and in Westphalia amongst miners. In 1880, amongst the navvies employed in piercing the St. Gothard tunnel it was very rife. In 1902 it was discovered in a Cornish mine.

The female of the ankylostoma is half an inch long. The eggs, found in the fæces, are oval and microscopic in dimensions. They are hatched outside the human body, and the resulting larvæ, being surrounded by a hard coating, cannot grow larger or reproduce themselves till they are either swallowed by a human being, or, more usually, penetrate his skin. From the skin, they find their way through the lymphatic vessels, first into the lungs, then into the bronchial tubes, whence they are coughed up, and, during the coughing, taken up by the gullet and so reach the stomach and their



THREE TYPES OF ROUNDWORM

(A) Ascaris, the intestinal roundworm (male and female); (B) pinworm, often found in children; (C) whipworm, one of the commonest human parasites—(all natural size).



TRICHINA LARVÆ IN MEAT
Larvæ of trinchina worms encysted in infected meat. These parasites are conveyed to man in under-cooked pork. (75 times natural size.)

ultimate home, the small intestine. The heat and moisture of mines and the naked bodies of the miners are favourable to their growth and invasion. In Porto Rico, where 30 per cent. of all deaths are ascribed to this disease, the coffee plantations are infested, the workers being shoeless and stockingless.

When the worms are in large numbers, the symptoms are severe anæmia and weakness, and where the larvæ are constantly in contact with the skin (forearms and hands) a characteristic eruption (called " bunches " by Cornish miners) appears. The weakness is partly the result of the bleeding into the intestines, a secretion from the mouth of the worm preventing the clotting of the blood ; and partly the result of the absorption of toxins excreted by the worm.

Oil of chenopodium is the most valuable medicinal remedy. It removes 75 per cent. of ankylostomata in one treatment of three 10-drop doses hourly, followed by a purge. Carbon tetrachloride is also said to be highly efficient.

The larvæ infect through bare feet in the case of plantation workers, who always are barefooted. The wearing of shoes is evidently the remedy. For miners, dirty hands, insanitary habits and polluted water should be remedied.

The Ascaris Lumbricoides (Roundworm or Eelworm) resembles the earthworm ; it has a pinkish colour and tapers at each end. The mouth is at one end and is surrounded by three projections or lips armed with fine teeth. The female worm is about twelve to sixteen inches long ; its organs of generation can contain at one time sixty millions of eggs. The mouse and the rat are probably the intermediate hosts by swallowing the eggs. These develop into larvæ which, through the respiratory passages of the rat or mouse, are deposited on food eaten by human beings. The worms live in the small intestine, whence they may be expelled in the motions or vomited. These worms are very apt to wriggle into ducts or passages such as the common bile duct, the larynx or the nose. There may be only one worm in the intestine or there may be a large number.

Symptoms may be absent or they may be the same as those of tapeworm. They may obstruct the bile-duct and so cause jaundice ; or, finding their way into the larynx, they may cause suffocation. Occasionally, a number of them rolled together may form a mass large enough to cause intestinal obstruction.

The presence of this worm is known by the discovery of its eggs microscopically in the stools. The earthworm is redder in colour, less tapering at its extremities, has bristles along its sides and is segmented.

The best remedy is oil of chenopodium.

With the exception of hookworms and ascaris lumbricoides, the Whipworm is the most common worm parasitic in man. This roundworm, about two inches long, is especially prevalent in warm countries, and infects man and monkeys. Its home is the cæcum (the first part of the large intestine), but it is occasionally found in the appendix. Usually its presence is only known by the

discovery of its eggs in the motions. This worm is thought by some observers to be frequently involved in the production of appendicitis. It is very difficult to expel, but oil of chenopodium is the best remedy.

The PINWORM (Threadworm or *Oxyuris vermicularis*) occurs almost universally at one time or another in children; it inhabits only the large intestine, generally the rectum, but it is also found in the cæcum. The depositing of the eggs on the clothes or on the skin around the back-passage causes scratching and soiling of the fingers and disseminates the infection.

Irritation, causing the child to scratch, is the chief symptom. This is generally worse in bed. There may be irritability of the bladder, causing frequency of micturition, or, in female children, a discharge.

Here again, oil of chenopodium is the most effectual remedy. Injections of infusion of quassia or of a solution of alum (ten grains to the ounce) into the rectum may also be used after emptying the bowel with a warm water injection. The itching may be relieved by mercurial ointment.

The TRICHINA SPIRALIS is a much less serious guest, so far as the intestine goes, than many other intestinal worms, its length of life as an adult being comparatively short.

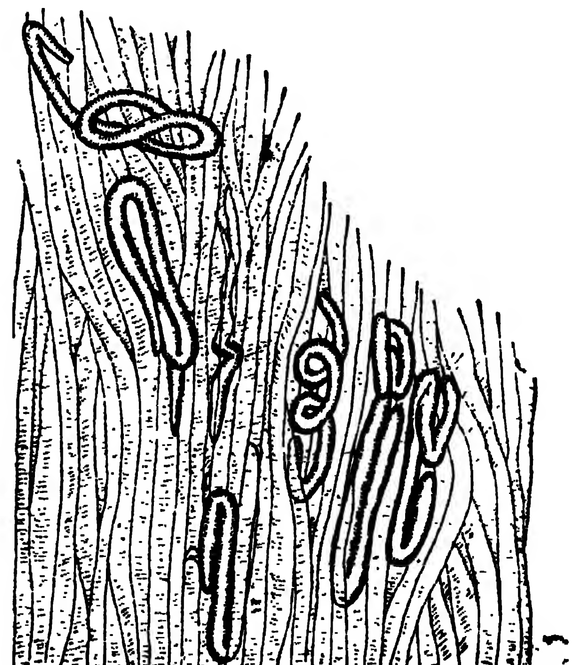
Trichina Worms.

The trichina worm is parasitic in rats, and is conveyed by them to pigs, in whose muscles they may be deposited in thousands. When such infected pork is consumed by human beings, within twenty-four hours sexually mature trichinæ are found in the intestine. The females are more numerous and larger than the males, measuring one-twelfth to one-seventh of an inch.

Within seven days, embryos are formed within the eggs and are discharged already hatched. The females bore their way into the lining membrane of the intestine and deposit the embryos in the lymph vessels which carry them into the blood and ultimately to the voluntary muscles. Here they reach their full size (one-twenty-fifth of an inch). Two or three weeks later they coil up and are surrounded by a capsule which is the result of the inflammation they provoke. With the exception of the heart, all the striped muscles of the body may be affected, but these capsules are always most abundant in the midriff, the muscles between the ribs, the biceps and the muscles of the larynx and throat.

The symptoms of trichinosis are fever and pain in the arms and legs; all movements being painful. The muscles of the limbs are tender and are hard and swollen. Mastication, yawning, coughing and sneezing are painful. At the end of the first week the eyelids are swollen, then the face and neck. The temperature ranges from 102° to 104°; the pulse is rapid; there may be profuse sweating. Death may occur in four or five weeks from exhaustion, pneumonia or bronchitis.

The symptoms are caused by a toxin excreted by the worm. When profuse diarrhœa occurs early in the disease—and this happens frequently in children—recovery is to be anticipated.



TRICHINA LARVÆ IN HUMAN FLESH

Larvæ are carried by the blood from the intestinal vessels to the voluntary muscles, where they become encysted in large numbers—larvæ before encystment (75 times natural size).

No specific remedy has yet been found. The worms in the intestine are very difficult to dislodge. The larvæ in the muscles cannot be reached by remedies.

As for preventive measures, they are summed up in abstinence from pork which is not thoroughly cooked. At least thirty to thirty-six minutes boiling should be allowed to every $2\frac{1}{4}$ lbs. of meat. Hurried roasting does not destroy the worm so long as raw portions are left in the centre. Cold storage for twenty days or more at below 10° destroys the trichinæ. Large pieces of pork left in brine have been found to contain living trichinæ for over a month. The only reliable preventive remedy is *thorough cooking*.

THE INSECT MENACE TO HEALTH

By L. E. S. EASTHAM, M.A., F.E.S., Lecturer in Entomology, Cambridge University.

INSECTS constitute the largest group in the animal kingdom, the number of known species far outnumbering those of the remaining animal divisions. It is not to be wondered at, therefore, that they exhibit a wide variety of habit. Some live in or on the ground, others again in water, while still more can be found living on other animals even from their own class. Indeed there is no known habitat from the sea to the desert and even to petroleum wells that has not been invaded by some insect or other.

This variety of habit is an indication of their wonderful success on the earth, and the adaptability which it reveals, enabling them to colonise any and every type of environment which the earth presents, is undoubtedly one of the prime causes of that success.

From among the large army of insects we may take a huge section including all those which are of some importance to man. These economic species may be useful or harmful and it is unfortunate that we have to relate that the battalions ranged against man vastly outnumber those working for his benefit. The harmful insects may devour growing crops to an extent which renders their future cultivation unprofitable. They may ruin the product of man's labour by attacking his stored goods. One unprincipled caterpillar actually bores into the cork of whisky bottles! They may attack his domesticated animals, infecting them with the germs of deadly disease so that whole tracts of country fall out of use and revert to useless bush land, as in parts of Africa. They may cause discomfort and disease to man himself. It is with the last category that we are now concerned. The importance of insects in a detrimental capacity to public health is well known to professional zoologists, doctors, and laymen alike. It is, however, generally left to special occasions to be emphasised, as in the massing of troops in war time or in times of abnormal disease outbreaks. That insects as disease carriers are a *constant* menace to man is not sufficiently and continually noted. Apart from the actual toll of lives which they exact, they impair the world's efficiency by enfeebling the health of its human population.

It is the striking examples of insects in relation to human disease which jump to the mind. The fact that the mosquito transmits malaria from one man to another and the probability that this disease caused the decline of the Grecian civilisation; that tse-tse flies by their transmission of sleeping sickness to man, and cattle disease to his stock, render large areas of Africa uninhabitable; that mosquitoes prevented the building of the Panama Canal owing to the infection of the workers with yellow fever; all these sufficiently drive home the importance of insects to man. But the reader will say these examples are all very well—we do not live in a mosquito-infested country; the tse-tse fly is restricted to Africa, the yellow fever mosquitoes to Central America and West Africa.

It is not, however, the insect that bites to let you know of its presence, and so figuratively shouts its infamy from the house

Courtesy] [*J. F. Corrigan, M.Sc.*

HOW FLIES CONVEY DISEASE

Flies settling and feeding on our food and utensils deposit there germs conveyed from previous contacts with diseased and putrefying matter.

tops which is the menace (though the mosquito menace must not be overlooked) but the non-biting fly which works in an invidious way, carrying disease germs in a passive fashion, poisoning our foodstuffs, even when set before us at table, and causing epidemics of sickness and disease, particularly among growing children. It is undoubtedly the non-biting fly of the common housefly type which constitutes the constant menace to health, and it is this type of creature which is associated with and tolerated by man over the whole surface of the earth from the filthy bazaars of eastern cities to the shops and dwellings of our better ordered cities of the west.

Common House Fly.

Insects like all other animals, pass from birth to maturity through two stages, one of growth, the other of reproduction and distribution. In order properly to appreciate the significance of such insects as houseflies to human health a short account of their life history is necessary. The common housefly, a familiar object to all, lays its eggs in batches about 100 to 150. Each egg is white, one-twenty-fifth of an inch long, and somewhat banana-shaped. The position chosen by the female varies, but in general the material in which the eggs are deposited is such as is likely to undergo a certain amount of fermentation. Rubbish tips and excrement of domestic animals and man are favourite places chosen by the fly. The egg hatches in due course often as soon as twelve hours after being laid, and a small white legless maggot emerges. This proceeds to feed on the surrounding filth. At the end of several days it is fully fed and it leaves the moister part of its feeding ground and finds shelter a few yards away. There now follows a period of apparent inactivity.

The grub shrinks within its outer coating which remains as a barrel-shaped covering to the pupa within it. This stage may last as long as a month and the fly which emerges at the expiration of this period is

[After Hewitt

FIRST STAGE OF THE HOUSE-FLY

The egg (20 times natural size) and the grub or larva of the housefly.

sufficient indication of the intense changes which have been going on inside whereby the white grub has been converted into the brownish-grey housefly. The fly is mature in about a further fortnight, and after mating, egg-laying begins the life cycle again.

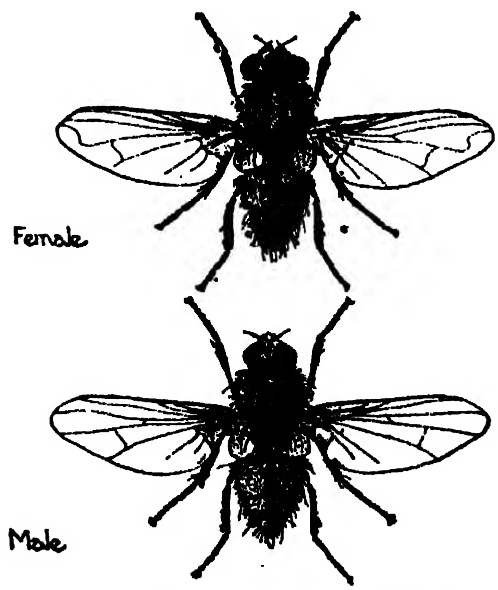
Since the fly is born in filth it is not to be wondered at that its body from the first possesses a possible and very probable endowment of germs, many of which are capable of causing disease. Such circumstantial evidence, however, is not sufficient to condemn the accused fly, but when we examine its habits we shall be more inclined towards a verdict of guilty.

Relation to Disease.

Its capacity for feeding is enormous ; even when fully fed the presence of food appears to stimulate feeding again, no matter whether the food is in the form of decaying matter or the delicacies of our table. To make this possible, it vomits part of its gut content on the new food supply and thus is capable of taking in another meal. By that very act it has deposited millions of germs on our food which we take in with equanimity. Even when not feeding, regurgitation is commonly indulged in, the drop of fluid being sucked up again from the substratum. Obviously the substratum receives its quota of germs each time this is done. Fæces are passed from the fly about two or three hours after a meal and experiments of Graham-Smith are of great importance here. This researcher found that flies fed on human sputum defæcated about six or seven times more frequently than flies fed on sugar and milk. That these facts are highly significant in connection with the bacterial contamination of food, particularly of the tuberculosis category, is obvious.

Of the many diseases whose distribution is attributable to houseflies, the most important are those caused by organisms living in the intestine of man. These are passed out in the fæces and one and all can be transmitted by mere contact with the fly or by fæcal or vomit spots after being taken up as food by the fly. Among such diseases we may note amœbic dysentery, typhoid fever, and summer diarrhœa.

Cholera, ophthalmic plague, smallpox, and diphtheria are all diseases with which the fly has a doubtful guilty association. If we examine a fly under a magnifying glass we see at once that it is admirably adapted for carrying particles of filth from one place to another. Its body is hairy and each hair or seta makes mere contact with any source of infection a serious matter. Its feet, admirably formed for walking on smooth and even inverted surfaces, consist each of a pair of claws, between which are two pads called pulvilli. Each pulvillus is closely set with hairs on its lower surface, and to these



Courtesy] [J. S. Bainbridge

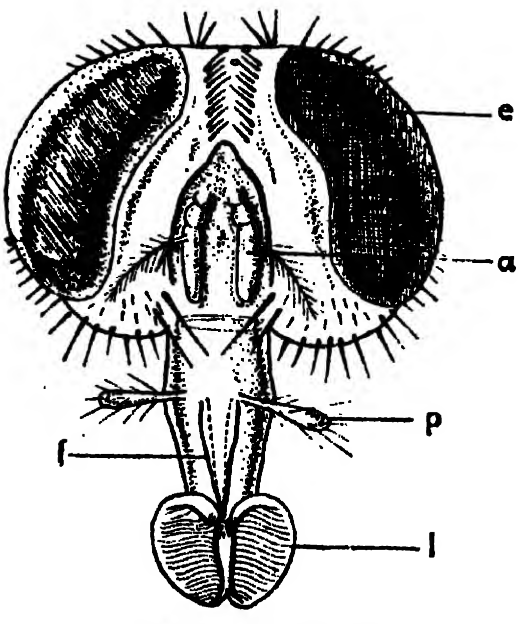
MATURE HOUSEFLIES

Above—female ; and *below*—male, much enlarged to show the hairs on the body, and the sex differences—in the head and veins of the wings.

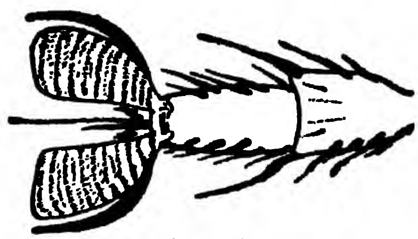
hairs filth and disease germs cling to be later brought to unprotected human food.

The apparatus by means of which it sucks up fluid is a complicated structure capable of folding up under the head when not in use. During feeding it is thrust outwards and downwards from beneath the head in the form of a proboscis. It is then that two sucker-like lobes are disclosed applied flatly to the surface. The under surfaces of these are traversed by minute channels opening to the surface by microscopic pores along their course and converging to a centre point. Fluid is collected by these channels to this point and from there drawn into the alimentary canal.

In the case of typhoid epidemics, the causative organism B. typhosus has been found on the feet, proboscides, and in the fæces of flies several days after their first contact with the source of infection, and "wild" flies caught in places where outbreaks were in progress have been found to be carrying the organism. Summer diarrhœa, one of the most serious diseases suffered by our infant population, is, on a



HEAD OF HOUSEFLY
Armed with a folding proboscis and suckers used for taking up food: *e* = compound eye, *a* = antenna, *p* = sense organ (palp), *f* = plates enclosing food canal, *l* = sucker-like lobes with collecting channels.



FOOT OF HOUSEFLY
The foot consists of a pair of claws and two pads set with hairs which convey dirt and germs to our food.

whole mass of circumstantial evidence, to be associated with the housefly. The curves of incidence of fly and disease in summer months correspond, that of the disease always lagging behind that of the fly. The flies have been observed clustering round the mouths and noses of infants suffering from diarrhœa and no doubt frequently visit diarrhœal excreta of older children. Breast-fed infants are less affected than those bottle-fed. These facts, while not yet establishing the definite connection between housefly and summer diarrhœa, lend general support to the theory that the fly is the dispersing agent. With regard to tuberculosis, experiment has clearly proved that flies can carry the bacillus and distribute it for several days after feeding on infected material. Sputum, being the common source of infection, should clearly be protected against flies. Though no definite evidence of infection of anthrax by flies has yet been obtained, experiment has clearly shown that the housefly does carry and distribute the causative bacillus, and moreover that flies merging from larvæ fed on contaminated materials are themselves infected and capable of distributing the organism.

The housefly (*Musca domestica*) has been taken as a central type because it is familiar and because owing to the excellent work of Gordon Hewitt, Graham Smith, Niven, Newstead, and others, its life history and associations with disease are well known.

Allied Species.

A number of allied species which include the Lesser Housefly (*Fannia canicularis*); the Latrine Fly (*Fannia scalaris*); the Blow Flies (*Calliphora erythrocephala* and *C. vomitoria*) are to be indicted on grounds similar to those on which we

NESTS OF THE HOUSEFLY

The eggs, deposited in batches of 100 to 150, are usually found in garbage and decaying matter. The flies are seen here in the larval stage.

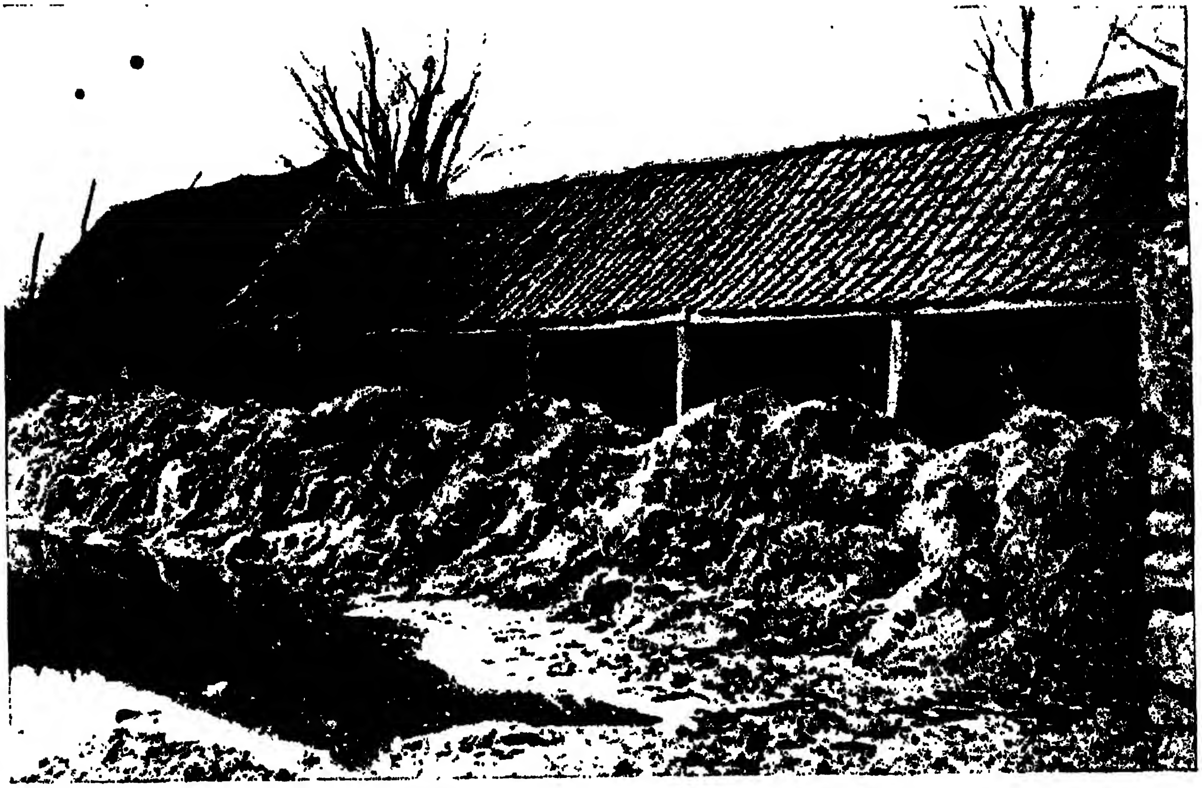
have judged the common housefly. No attempt is being made to enable the reader to particularise between these species. To do so adequately would take up too much space and so many technical terms would creep in that the reader would be little wiser in the end.

The following points may help: When bred under normal conditions, Musca domestica measures about 6.5 mm. in length. The wing-bearing region or thorax is greyish, the abdomen brown with a median blackish brown line. Fannia canicularis and Fannia scalaris are smaller, measuring only 5.5 mm. in length and the thorax is darker grey. Calliphora erythrocephala and Calliphora vomitoria may be 13 mm. or only 7 mm. in length. The bluish-black thorax and the dark metallic-blue abdomen together with the larger size easily pick out these "blue bottles" from their smaller, greyer cousins. In general, we may say that the life histories of these various species of flies follow the same course. They differ rather in the kind of material which is preferred by the female fly for the deposition of her eggs. Thus, while Musca domestica prefers decaying vegetable matter such as is found in unclean dustbins, the blowflies, Calliphora erythrocephala and Calliphora vomitoria prefer to place their eggs on meat. This habit alone renders them liable to act as carriers of anthrax. Their habit of frequenting fæces as a source of food rather than as an egg-laying site places them in a category with Musca domestica as carriers of intestinal bacilli.

The breeding habits of Fannia scalaris, the latrine fly, and to a slightly less extent of Fannia canicularis, the lesser housefly, are even more revolting to relate than those of the house and blowflies. Their preference for human fæcal matter as breeding ground is most marked and untended privies in summer will contain large numbers of the grubs wallowing in the noxious contents. The grubs of both these species are distinct from those of the house and blow fly in that they possess prominent lateral and dorsal feathery like processes. Knowing from this that the fly frequents such places both for food and egg-laying and indeed has its birth in such an environment, is it not a matter of considerable surprise that it is tolerated in our living rooms where food is displayed?

Those living under the most hygienic conditions in towns where sewage systems are the rule, are not free from the visitations of such insects. They all have great powers of spread, as was proved by Hewitt in his excellent work at Manchester and at Ottawa. Flies centred on certain breeding places were captured in large numbers and "marked" by spraying them with rosalic acid in alcohol (such flies subsequently caught on fly papers produce a scarlet colour when dipped in slightly alkaline water). They were released and fly papers examined in houses at various distances from the starting point. The result of these experiments showed that in a crowded city flies have a certain range of 700 yards, and in open country flies were recaptured 1700 yards from the point of release.

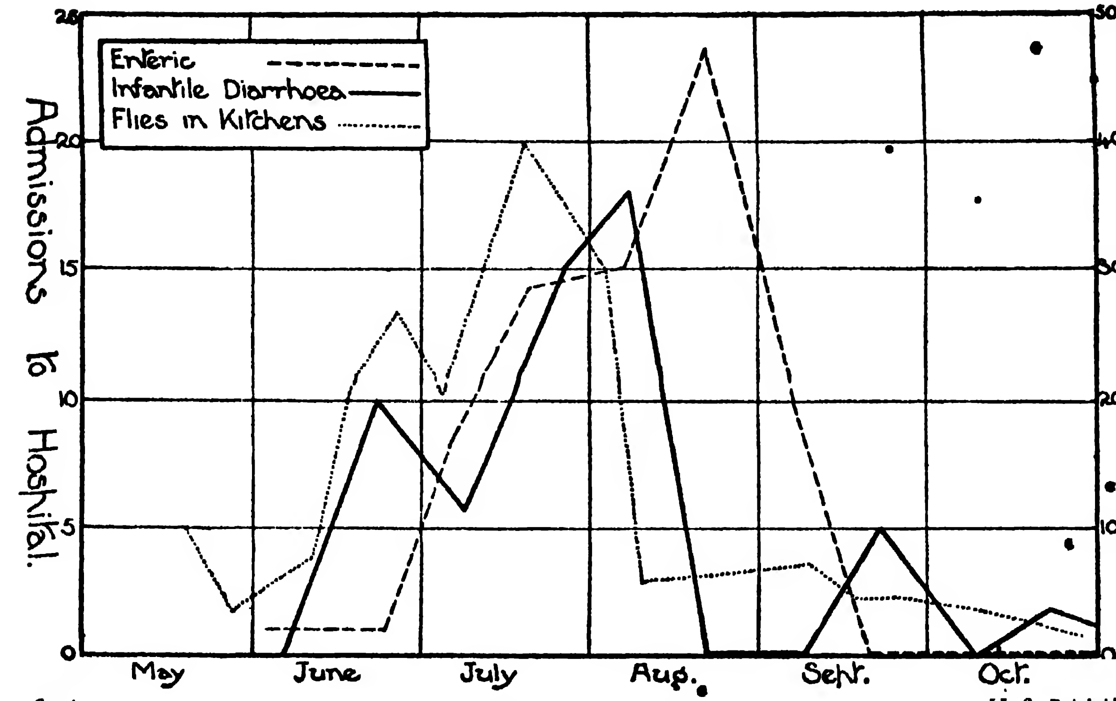
From what has been said it will be clear that the problem falls under two headings. The first is that of removing as far as is humanly possible all material in which flies are interested for egg-laying. The second consists in protecting our food from fly contamination. In these two treatments, attack and defence against the fly, we have the essential features of a war waged against an enemy that is worthy of our best efforts.



Courtesy] [Central Council for Health Education

THE FLY MENACE—HOW IT CAN BE CONTROLLED

Refuse from stables and cow byres is an ideal breeding ground for flies in great number. The adoption of hygienic types of milking sheds, such as that shown below, is an important step towards controlling these pests.



Courtesy] [J. S. Bainbridge

FLIES IN RELATION TO DISEASE

These graphs (Royal Army Medical College) prove the intimate connection between the prevalence of flies and infantile diarrhœa and enteric fever.

Suggested Measures.

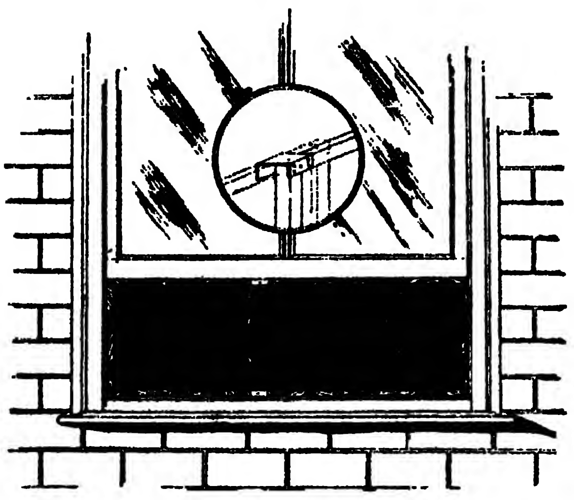
How are we to wage this war? Malaria conveyed by the mosquito is eradicated by the abolition of mosquito breeding grounds. The fly problem is the same. The measures employed should be aimed at the abolition of breeding grounds. A study of the breeding habits has clearly revealed the main breeding grounds for the most harmful species. Stable refuse must be protected from flies either by placing it in fly-proof pits or by treating it with insecticides. This is a matter for municipal authorities to make the necessary bye-laws and to see that they are enforced. Where possible the storage of stable refuse in such places as railway depots and canal wharves should be discouraged. The increase in motor transport has greatly reduced the number of livery stables in our towns in recent years, but in this fact alone there is a menace since the few which remain often lack the necessary inspection on the part of sanitary authorities. The insanitary privy, rapidly becoming a thing of the past, is the greatest menace. It is a still common feature of our villages, and where it still exists the greatest care and attention is necessary. Earth or ashes should be plentifully scattered over the fæces at least three times a day. "Thou shalt have a place also without the camp whither thou shalt go forth abroad: and thou shalt have a paddle among thy weapons; and it shall be when thou sittes down abroad thou shalt dig therewith and shalt turn back and cover that which cometh from thee." Thus ordered Moses (Deut. xxiii. verses 12 and 13), and in doing so showed he had perhaps a clearer notion of the relation of flies to disease than many of the municipal authorities of the latter half of last century.

In some of our largest towns to-day spare ground is still used as dumps for garbage heaps. That these constitute breeding grounds for flies is evidenced by the high fly population with which the surrounding houses are plagued during summer months. Private rubbish bins should be frequently emptied, the contents burned, and the empty tins well disinfected. Even the innocent rabbit hutch with its inmate kept as a pet for our children must be properly and

regularly cleaned. An unclean rabbit hutch is a favourite breeding place for the latrine fly. Measures aimed at removing breeding grounds therefore call for prominent action on the part of municipal authorities, but unless each and all in a private capacity make action in concert with the authorities the good work set in motion by the latter will be largely nullified.

Purely protective or defensive measures depend on individual effort to a large degree. It is true that foods offered for sale might come under the jurisdiction more strictly of the municipal authorities. Exposure of food such as milk, confectionery and meat in positions where it is open to the visits of flies should be strictly prohibited. In this respect the United States of America are distinctly in advance of us and their enclosure of food beneath fly and dustproof glass covers in eating houses is greatly to be admired.

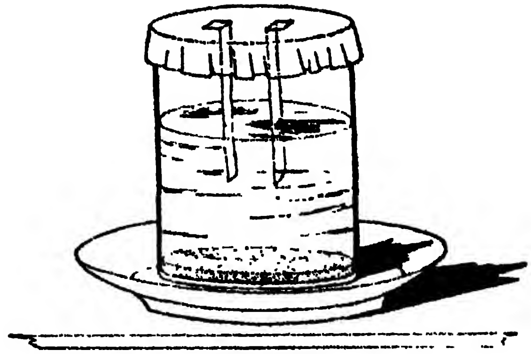
For the private individual it is an easy matter to cover all food in such a way as to allow free access of air and still exclude flies. Protective gauze over pantry windows, metal gauze covers which adequately cover exposed food in dishes, muslin covers for cream and milk are a few of the simple precautions which all and sundry can take without going to any great expense. Lastly,



Courtesy] [J. S. Bainbridge

A FLY SCREEN FOR THE WINDOW

An adjustable gauze fly screen in two sections, showing how it can be made to fit a window of any width (inset).



Courtesy] [J. S. Bainbridge

A SIMPLE FLY TRAP

The poison (formalin ½ oz., sugar ½ oz., lime-water ½ pt., water ½ pt.) runs up the blotting-paper wicks and damps the blotting-paper cover, where it is absorbed by the flies.

those having the care of infants and invalids should take all precautions to exclude flies from the nursery and sick room. The trapping of flies by sticky papers or by the use of poison bait should be carried out where they occur in large numbers in houses. A good fly bait can be made by taking a pint of equal parts of water and milk and adding to this two tablespoonsful of strong (40 per cent.) formalin. This is exposed in saucers and proves an attractive bait for flies to which it is fatal. A very effective trap is the "fly balloon" of wire gauze, which may be baited with cheese, banana, etc. Much can also be done to clear flies temporarily from a room by "swatting," especially by the concerted action of several people at once. They can also be got rid of by spraying with one of the many proprietary sprays, but, since these mostly only stupefy the flies, the latter should be immediately swept up and burnt.

It cannot be sufficiently stressed that organised effort to destroy flies is essential and one can heartily agree with Hewitt when he says "that all citizen organisations should begin campaigns for clean cities. Flies and filth are synonymous terms. In a clean and sanitary community flies will be unable to exist in dangerous numbers and their absence may be taken as a measure of cleanliness. The time must come when men will realise that it is easier to prevent disease than to cure it and less costly in terms of human life."

Courtesy] [*Medical Officer of Health, Salford*

THE CAMPAIGN AGAINST THE HOUSEFLY

A window display at the Salford Health Offices, designed to emphasise the housefly danger.

HOUSEHOLD PESTS

By J. DU P. LANGRISHE, M.B., D.P.H., Lecturer in Public Health to the University of Edinburgh.

MUCH discomfort, loss of health and sickness results from infestation by certain insect and animal pests; considerable material loss, too, is incurred through the damage done to foodstuffs and property by their depredations.

Of recent years attention has been increasingly directed to this subject which has now developed into one of the very first importance both in matters of health and general economy; so much so, indeed, that control of some of these pests is now required by legislation, action being demanded not only on the part of public authorities but by the individual as well. It is hoped, therefore, that the following somewhat brief accounts may be of assistance to the householder in tackling his share of the problem.

RATS AND MICE

In 1919 Parliament placed upon the Statute Book an Ordinance which makes it an obligation that every citizen shall faithfully and dutifully kill every rat and mouse within his or her house—indeed, the Act goes further, and makes it an offence should the citizen default in this duty.

It may be thought a hardship that a leisure-loving citizen should be called upon to wage war upon rats and mice, whose company he does not mind in the least, but, civilisation is compelling us, more and more, to the realisation that we cannot live to ourselves alone, and that we must share one another's burdens. It might be apposite to explain why Mr. B. should be forced to kill his rats and mice. Mr. B. is flanked on his

left and right by A. and C., and, therefore, A. and C., who, we may suppose, have a hatred for rats and mice engendered by either economic or health prejudices, have a distinct grievance against B. when he infests them with his surplus stock. The same argument applies, of course, in every city, town, and village.

The rat can be traced back for three thousand years, and then disappears in antiquity, for long before the Christian era, as Boelter reminds us, the Egyptian cat was worshipped as a natural protector of grain from rats and mice. Indeed, as the same author tells us, a Roman accidentally killed a cat during the time Ptolemy of Egypt was doing all he could to make himself agreeable to the Roman power, but, this notwithstanding, Diodorus Siculus, who was an eye-witness, relates that even the terror that the name of Rome inspired could not save the unlucky Roman from punishment.

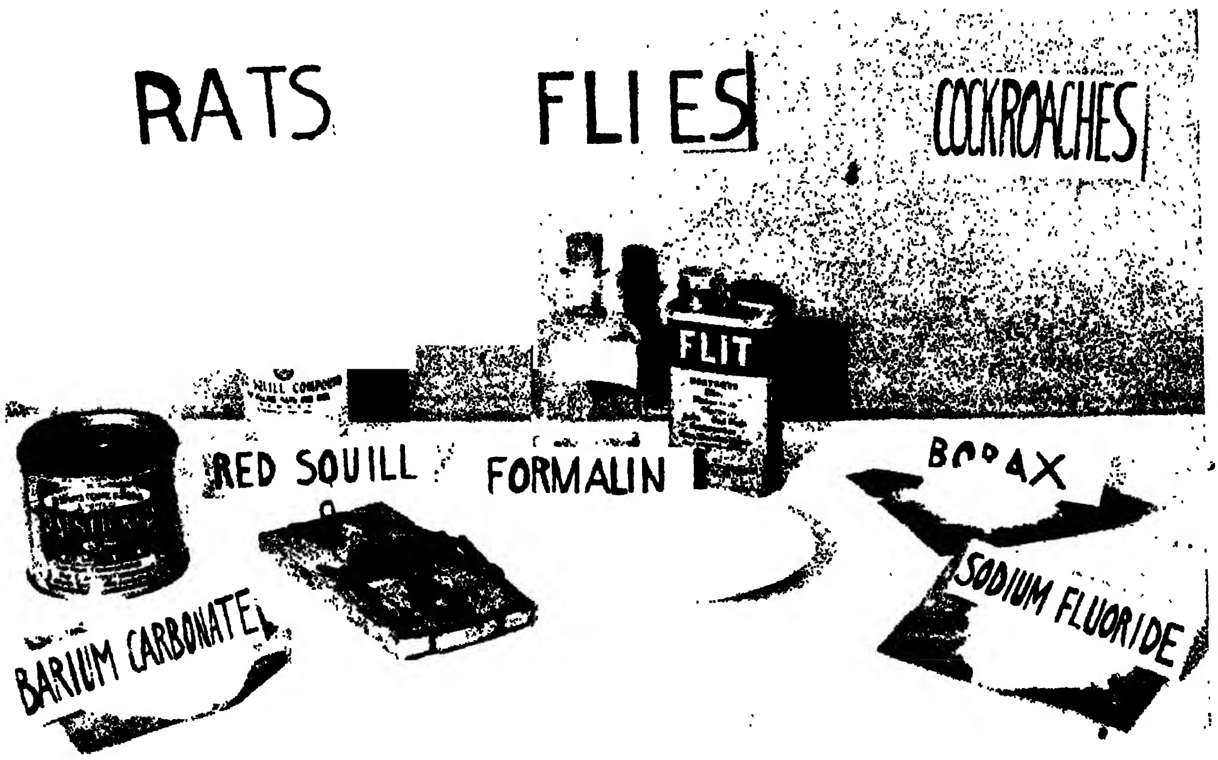
Origin.

In ever increasing waves, remorseless, destructive, disease-spreading, penetrating and cruel, the rat scourge sweeps on. Man, King of the World, affects contempt—sometimes amused, sometimes indifferent, while silently his subterranean foes push on, destroying his grain, his fruit, his produce, his animals, his poultry, and the very foundations of the houses and dwellings of man.

Armed by nature with cunning of a superlative kind, paws of delicate, sensitive and dexterous character, the rats, whose teeth are like finely pointed blades of highly tempered steel, wander purposefully in their hordes, and their wanderings converge to the establishment of a mighty kingdom.

Man is no king in the rat world, for his implacable foes laugh him to scorn as they multiply and levy, day by day, a tremendous toll in goods and kind, while man, in his puny efforts to withstand a foe which is enveloping him like a creeping tide, is actually to-day spending in England alone close upon fifty thousand pounds annually in direct efforts to destroy

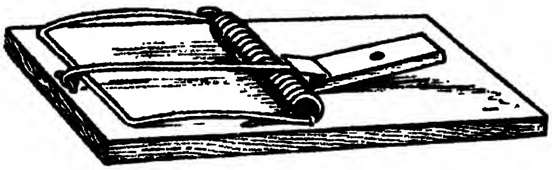
Economic Loss.



Courtesy] [*"Good Housekeeping"*

POISONS FOR VERMIN

Three groups of poisons most commonly used to exterminate rats, flies, and cockroaches respectively.



THE "NIPPER" TRAP
This rat trap should always be set in a "run," and should be set "safe" for some days before use.

these vermin, which are costing this country at least 150 million pounds per annum.

Lest it be thought that the menace is one of simple dimensions, one should add that rats commence to breed when they are three months old, and that it is competent for one female rat as a result of six to twelve litters, each consisting of from six to twelve young, to add at least 1000 rats to the world's store in sixteen months.

Careful feeding experiments conducted over a considerable period prove that both the rat and the mouse are selective feeders, and that they do not, in their natural wild state, subsist on crusts of bread and bits of dried cheese; rather, they prefer such things as bananas and eggs.

It is on record, however, that rats have carried away eggs, nuts, condensed milk, bacon, sponge cakes, young rabbits, partridges—and in every form they have proved themselves omnivorous feeders.

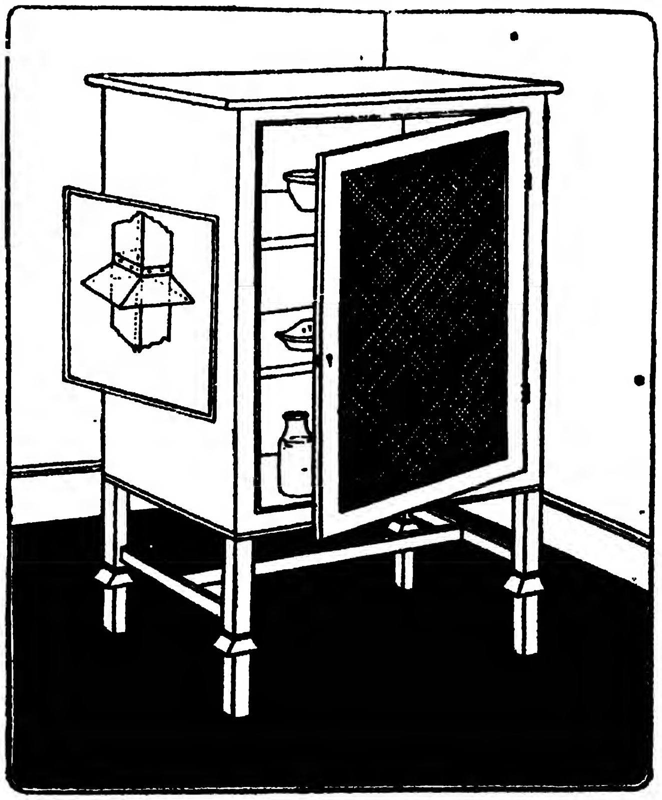
Having these facts in mind, and harking back to the cost, it will be seen that, even if allowance be made for food consumed in the process of scavenging, a modest estimate of edible material consumed or damaged would not place the amount as being less than a penny per day per rat, or less than a halfpenny per day per mouse.

Therefore, pursuing this line of argument and assuming, as careful research warrants us in assuming, that the rat population is equal, at least, to the human population of this country, and that the mouse population is as many again (viz., 97 million mice); an easy sum in arithmetic will show that the 150 million pounds per annum is, if anything, an under-estimate, and this estimate ignores the losses caused by other damage and by rat-carried disease.

Disease Carriers.

We know that rats carry plague, trichinosis, malignant jaundice, parasitic mange, and rat-bite fever, and we know that they have not yet been acquitted of all complicity as regards foot and mouth disease—these things we know, and they are for the moment sufficient; moreover, they should be ample to stimulate the thinking community into energetic action.

All this makes rather sensational reading, but there is a more terrible part of the indictment against the rat, which comprehends its love for human flesh. Again, the immense damage done in its search for food and water—when electric lights are cut off, flooding and housefires are caused by its depredations—all these find a legitimate place in Mr. Rat's black list. The mouse, by reason of its



Courtesy] [*"Home Pests and Their Destruction,"* *J. S. Bainbridge* (*Heinemann*)

A MOUSEPROOF MEAT SAFE
An inverted funnel (inset) is fixed to each leg to prevent mice from running up. A larger guard can be used for rats, and a similar device can be fixed to larder shelves.

ubiquity and its natural engineering implements in teeth and paws, is hardly a less formidable foe.

Methods of Destruction.

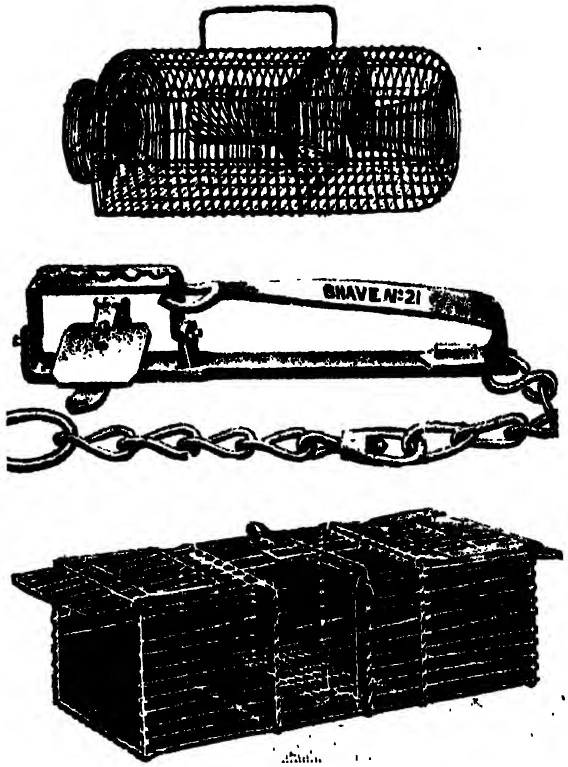
Many attempts have been made, and will continue to be made, to exterminate these rodents, and one is hard put to it when invited to advise upon their extermination, because there is no "royal road," simply on account of the fact that the rat and the mouse have a highly acute, well-developed cunning brain.

Biologically, the method advocated by Mr. Rodier of trapping and killing all the females, and turning the males loose, is perhaps the soundest method of all; but, as far as one can see, unless the whole process of rat and mouse destruction is centred in the State, while individuals are prohibited from interfering in any way, the plan presents immense difficulties in being carried out in a practical manner.

(*a*) PROFESSIONAL RAT-CATCHERS.—It is often desirable and expedient to employ a professional rat-catcher, for it seems essential that this class of highly necessary citizen, if properly trained and registered, should be given some status by the Government. Often a rat-catcher with his ferrets, traps, nets, dogs, guns, poisons, and highly specialised knowledge, provides in himself all the machinery to deal with the pest in an organised manner.

(*b*) POISONS.—Among the poisons, the safest are, undoubtedly, preparations made up of either barium carbonate or red squill. Phosphorus in trained hands is an excellent raticide, and, it is said, the most effective preparation for dealing with mice. Arsenic is undesirable because it is stated to cause the dead rats to burst, and, when this occurs under the floors, they give off an offensive odour. Strychnine, owing to the extreme danger of small doses to man, should never be employed except by a professional, and then it is a very effective and deadly chemical. Virus is useful on farms and small holdings, but if used constantly the rat population is liable to become immune to it.

Poisons must be freely exposed simultaneously over large areas; it is futile to bait only a small area at a time—rats simply leave it and go elsewhere. Any of those poisons enumerated above can be used either in the form of pills made up with oatmeal and dripping, etc., or, mixed with some vehicle attractive to rodents—*e.g.* aniseed oil—and spread on bread which is then cut up into small cubes. The same poison should never be used for two consecutive baitings, and it is desirable also to vary the substance in which the poison is presented. Lay one bait per yard along rat runs and under raised building stacks, etc., and allow ten days to a fortnight to elapse before again laying poison. It seems hardly necessary to add that every precaution should be taken to safeguard human beings and domestic animals, due notice being given when it is proposed to put down poison.

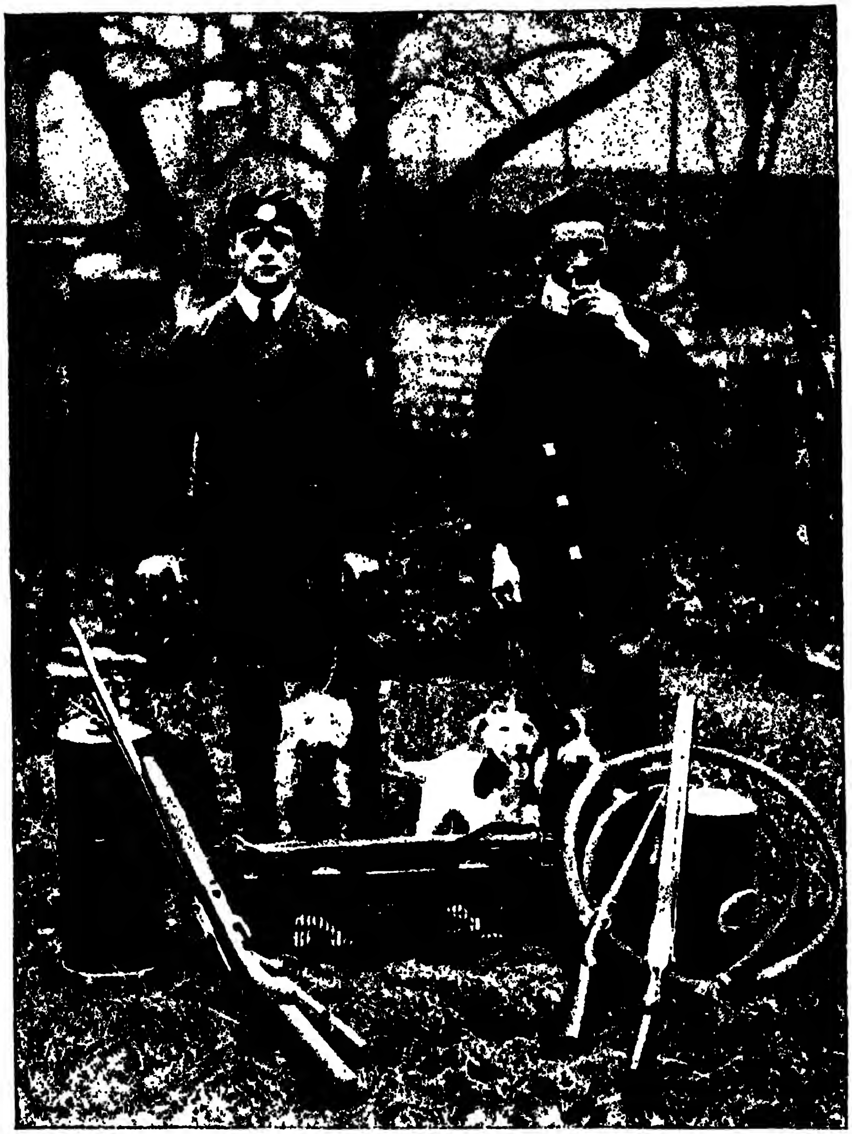


Courtesy] [*Army and Navy Co-operative Society*

COMMON TYPES OF RAT TRAP

Two wire cage traps, which must be carefully disguised if they are to be effective, and (centre) a simple "gin"—one of the most successful types.

(*c*) TOXIC GASES.—Gassing, if properly carried out under suitable conditions, is a



THE WAR AGAINST THE RAT [Photopress
The weapons of the professional rat-catcher, including ferrets, poison, and poison-gas.

one inch thick and four and a half inches in length; these should be ignited and thrust into burrows, all holes, of course, being stopped up. (2) Chlorine —also a heavy gas—best used from a cylinder. (3) Carbon bisulphide—again a heavy gas—obtained in liquid form, which is soaked up in tow, etc., and thrust into burrows; it is highly inflammable. (4) Hydrocyanic acid; this is highly dangerous and is lighter than air; it should only be handled by those who have experience of it.

(*d*) TRAPPING.—Trapping forms the backbone, or stationary warfare stage, of the campaign against rodents, during the intervals between the attacks by poisoning.

There are many and various kinds of traps, both on the market and improvised—many of them almost useless, some effective. The rat, as we have said before, is exceedingly cunning, and therefore we must meet him with even greater cunning. There are two things that must be borne in mind—first, a trap must not be obvious, and, second, a rat will not enter anything strange which he cannot see straight through.

One of the most successful types of traps is the simple "gin" trap such as is used for catching rabbits. Another is "the nipper" or "break-back" kind. There are various ways of setting these, which should always be set in a "run," but best results will be obtained if the trap is set "safe" for some days before actually being put into use. No bait is used, the traps being set where rats (or mice) must pass over them. One method

most salutary method for destroying rats. It is necessary that gases should operate in a confined space, such as in the holds of a ship or in burrows and warrens, where they can be concentrated.

The most suitable gases are (1) Sulphur dioxide, a heavy gas which is most conveniently used either from a cylinder or by the agency of a Clayton's machine. Another method is by means of "smoke ferrets"; these are sulphur candles made up thus: mix sulphur one part with nitre two parts and work them up with sufficient tallow to bind the mass, finally rolling it into sticks

is to cover the trap with a wire tunnel about seven inches high; another is to set it just submerged under water; yet another is to cover it with earth, sawdust, oatmeal, etc.

Boards, coated with strong bird-lime and baited, may be laid in runs, particularly in buildings.

Rats and mice *must* have food, and they will always patronise that which is easiest to obtain. Hence it behoves us to see that *all* our food is kept so that rats and mice cannot gain access to it. Thus, for example, larders should be rendered proof against these marauders; grain should be stored in metal bins with tightly-fitting lids. Neither let us forget the dust-bin, the food scraps in which are, alas, only too often easily accessible.

Food Protection.

RAT-CATCHERS AT WORK [*Photopress*

The modern poison-gas methods being applied in the extermination of rats.

In this connection, one should also mention the protection of corn-stacks, which not only supply abundant food for rats and mice, but at the same time provide them with a snug home. All such stacks can be rendered rat-proof by raising them off the ground on metal posts covered by inverted hollow metal caps about twelve inches in diameter.

This brief summary by no means exhausts the means at our disposal for attacking these pests; much further information, with greater detail of what has been outlined above, can be found in the following pamphlets: Ministry of Agriculture and Fisheries, Miscellaneous Publications No. 22, and Leaflet No. 244; British Museum (Natural History), Economic Series No. 8; the Zoological Society of London, *Report on Methods of Rat Destruction.*

One cannot conclude without reminding the reader of the usefulness of the domestic cat—if not over-fed in the home.

MOSQUITOES *

It is not unusual to read in the daily press during the summer or autumn that so-and-so has died as the result of having been bitten by a mosquito. This in the British Isles! Few there are of the general public who

* For "Flies," see page 28 *et seq.*

realise that the common gnat, which can make miserable our leisure hours out of doors on a summer's evening, is nothing more nor less than a mosquito. Who has not vivid recollections of the torment of these pests, and probably, in addition, of the subsequent suffering due to inflammation resulting from their bites?

But this is not all. Certain species of mosquitoes which flourish in the British Isles are known transmitters of malaria. Add to this that hundreds, possibly thousands, of persons return from tropical countries every year, most of whom have suffered from malaria and are carrying in their blood the parasite of that disease. What may happen? One of these mosquitoes may bite such a person and imbibe the germs which, in due course, it may pass on to many other individuals. This, indeed, is what *does* occur, and *has* occurred many times in the past. It is possible, therefore, for malaria to break out and lay low large numbers of people.

We may say, however, that it is not so much the danger of an outbreak of malaria, but the very great amount of discomfort, disability and even grave illness resulting from inflamed mosquito-bites, that calls out for alleviation.

There being no less than twenty-six different species of mosquitoes existing in the British Isles, it is manifestly out of the question here to attempt to enumerate and describe them; but there are certain points common to all which enable us to tell whether an insect is a mosquito or not, and whether it is a male or a female, a matter the importance of which will shortly appear.

If we examine a mosquito with a magnifying glass, we notice that (*a*) the ribs or "veins" of its wings have a simple and definite arrangement, the second, fourth, and fifth (counting from the front edge backwards) being forked; (*b*) a fringe of tiny scales runs all around the margin of the wing, the margin also being thickened all the way round; (*c*) projecting forwards from under the head is a long slender stylet or proboscis adapted for piercing; (*d*) on either side, and slightly above this, is a pair of antennæ or "feelers," which in the male are richly "plumed" or bushy. These points are quite sufficient for distinguishing this insect from non-biting midges.

Like the housefly, a mosquito in the course of its development passes through a complete series of changes or metamorphosis, but these changes differ from those of the fly in that all the stages prior to the emergence of the adult *take place in water.*

Life History.

The eggs are laid, either singly or in "rafts" resembling pieces of soot, on the surface of water in marshes, ditches, edges of streams, ponds, holes in trees, cisterns, broken crockery, etc., etc., where, in the course of a few days, the eggs hatch into larvæ or "wrigglers." The larvæ are very active, moving about in the water with a "flipping" or wriggling action, feeding on minute matter and from time to time rising to the surface to breathe. This they do by means of a tube or "syphon" projecting from the hind end of the body. Whilst breathing, the larva is still, and it may be noted that it either hangs downwards from the surface—in which case it is a "Culex," or lies horizontally just beneath the surface, when it is an "Anopheles" (one of the malaria carriers). These grey larvæ are to be distinguished from the so-called "bloodworms" which are the larvæ of a non-biting midge.

This stage lasts for about a week, during which time the larva grows to about a quarter of an inch in length and moults its skin several times until it is ready to turn into a chrysalis or pupa. It ceases to feed, and after the final moult appears as a comma-shaped object with two trumpet-like organs, or breathing tubes, projecting upwards from the thick portion. In this phase it does not feed, but remains most of the time at the surface breathing, the while the adult mosquito is forming inside the case.

After the lapse of a further two or three days the case splits and the fully grown adult emerges and remains for a time poised on the empty case until its wings expand in readiness for its initial flight.

The periods given for the different stages are the shortest that may be expected in the British Isles. As a matter of fact, it is usual for only two broods to hatch out each year, namely, those which have been carried over from the previous season in the form of hibernating larvæ which pupate and hatch out in the spring, and a second brood in the summer which are the offspring of the former generation, the succeeding one being carried over the following winter as larvæ to emerge in the next spring.

Thus we see that breeding is quiescent during the winter months, hatching and emergence of the adult taking place only during warm weather.

Courtesy] [Central Council for Health Education

FIGHTING INSECT PESTS

An American poster used as propaganda against flies and mosquitoes.

Habits.

Mosquitoes are by nature vegetarians, subsisting, for the most part, on the juice of leaves. It is only when the female desires to lay eggs that she indulges in a feed of blood, for this is necessary before she can perform this function. The *male* does *not* require blood and therefore *it is the female alone which bites us.*

They do not like bright sunlight or strong wind—hence their predilection for sheltered, shady sites, and their activity in the late afternoons and evenings. The insides of houses, byres, stables, etc., are attractive, being comparatively dark by day and affording warmth and protection from the elements. Once indoors, the female does not go forth again until she is ready to deposit her eggs on the nearest suitable water surface, and it is at night, when we are comfortably tucked up in bed and hoping for refreshing sleep, that she comes to the attack, it may be silently, but more usually with a "pinging" sound elusive in the darkness. Good-bye, then, to a good night's rest while that mosquito is at large in the room.

It has been mentioned above that larvæ hibernate throughout the winter (in water, of course), but there is another way in which the insect bridges this period. In the early autumn large numbers of mosquitoes gather in byres, stables, poultry-houses and other warm places where they may be found resting

by day, and remain throughout the cold months, the females taking occasional feeds of blood from the hapless animals or human beings on whom they have inflicted their company.

It will be obvious now to all who have carefully followed the life-history and habits, how the breeding of mosquitoes may be prevented, or, at least, diminished.

Fighting the Mosquito.

Let us, then, seek to reduce the possible breeding-places by taking advantage of the lull in breeding which occurs throughout the winter when we can eliminate most of the likely breeding places, or, at any rate, render them unsuitable. Thus, we can empty and clean out garden ponds or stock them with goldfish, for these are voracious eaters of mosquito larvæ particularly if other food-supply is scanty; examine old trees for holes containing water and fill up these with cement. The country property owner must also keep his ditches clear so that water will not stagnate; he must drain his marshy land where this can be done; and so on. Remember, however, that mosquitoes will breed in any collection of water, however small - even in old bottles, broken crockery, empty tins, etc.

Where larvæ already exist in such places as marshes or ponds which cannot be drained or filled, they may be exterminated by spraying the surface with oil, by dusting with "Paris Green," or diluting the water with a poisonous substance. Ordinary paraffin oil will be efficacious for small surfaces, but it is very expensive and too light when it comes to using it on a large scale. The cheapest —and at the same time a very effective—form is waste oil from motor garages. This can be sprayed either from an ordinary garden syringe or by means of a portable sprayer. The quantity required is in the proportion of ½ pint to every twenty square yards of water surface. The oil kills the larvæ and pupæ by forming a film on the water which prevents them from breathing.

"Paris Green" is a direct larval poison suitable rather for large expanses of water or marsh. It is quite safe both to man and domestic animals if employed strictly in accordance with the directions for its use. Another poison which has been used with great success is "White Cross" disinfectant, but for the detailed use of this, and other poisons, we must refer the reader to pamphlets and works on the subject.

When a mosquito has entered a house or other building it has more or less placed itself at our mercy. For here, being in a confined space, it can be easily attacked and destroyed.

The most convenient method is by spraying, especially in cellars, stables, and out-houses generally. For this purpose a mixture is recommended consisting of paraffin oil, carbolic acid and water in equal parts—a useful combination for destroying most kinds of indoor pests.

In inhabited rooms spraying with such a mixture would prove highly objectionable, and we must, perforce, resort to other methods. A good device is that employed in Holland, and referred to by A. M. Hogarth in his book, *British Mosquitoes*. It consists of a wooden bowl or small open box mounted on the end of a pole by means of a swivel joint. The bowl contains a pad of cotton wool soaked with petrol in which pyrethrum (of which "Keating's Powder" is a form) has been dissolved. The bowl is placed against the ceiling or wall on which the mosquitoes are resting, when they become stupefied by the fumes and fall into the wool which is burnt after the room has been cleared. Fumigation, by burning Keating's powder, stupefies the mosquitoes, which can then be swept up and burnt.

Other means of attacking are by "swatting," making use of one of the familiar wire-gauze fly-swatters for the purpose; or again, vacuum cleaners have been used successfully for catching mosquitoes, but when these are collected in the container they should be burnt and *not* placed in the dustbin to escape once more.

Personal Protection.

In this country one need hardly go to the length of rendering houses mosquito-proof or even of sleeping under mosquito-nets. It is usually sufficient to apply to the exposed

THE CAMPAIGN AGAINST THE MOSQUITO [Photo

Spraying a stream at Wimbledon with paraffin to destroy mosquito larvæ.

parts of the body some substance which will discourage the insect from approaching.

There are many such "repellants," but a good one consists of an ointment made up of oil of cassia one part, oil of camphor two parts, vaseline three parts. This should be lightly rubbed on to exposed parts of the body. Petrol has been strongly recommended, and is applied by lightly rubbing over the skin with a piece of rag or a pledget of cotton-wool which has been saturated with it. Oil of citronella lightly applied to exposed parts is another good repellant, but its effect is rapidly evanescent.

Treatment of Bites.

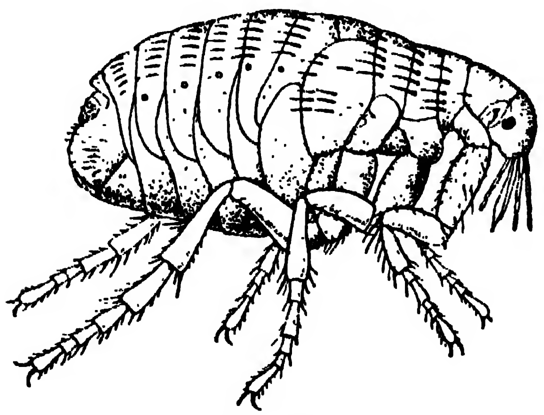
It is difficult to give any one method which will find favour with all, since the reaction of different individuals to bites varies very greatly. A safe application, and one likely to reduce the risk of subsequent inflammation, is tincture of iodine. With some persons, the application of benzene or ammonia will allay irritation and so prevent the inevitable scratching with the finger-nails, which is so potent a cause of infection of the bite. In many cases ordinary washing soda applied to the bite will give relief.

FLEAS

With what instinctive horror and repugnance do we regard this minute pest! And instinct is not at fault, for the flea is definitely known to be a transmitter of that dread disease bubonic plague, from which between the years 1896 and 1911 there were 7,000,000 deaths in India alone. The whole of the East is constantly under the menace of this

disease, which is always present somewhere, and from time to time flares up into a gigantic outbreak. Bubonic plague is not unknown in the British Isles--the Great Plague of London was none other than this, and occasionally a case arrives at one of our ports, while outbreaks have actually occurred as recently as 1900 and 1910.

The flea is suspected of conveying other diseases and is known to be the host of an intermediate stage of a tapeworm, but, as with the mosquito, it is the discomfort of the itching resulting from its bites with which we in temperate climates are chiefly concerned, not forgetting, however, the greater danger lurking in the background.



THE HUMAN FLEA
Eighteen times natural size.

About 500 different kinds of fleas have been described, and of these at least eight are known to carry plague, while there are some forty-six species in the British Isles parasitic on man, animals, or birds.

These insects, like many others, undergo complete changes of form or metamorphosis, passing through the three stages of egg, larva or maggot, and pupa or cocoon before emerging as adults.

Life History.

The eggs are deposited--according to the species of flea—on the host's body or in cracks in floors and walls, and in dirty and dusty places generally, hatching in from two to ten days, which period may be much prolonged by cold and drought. From the egg emerges an elongated bristly larva which moults twice during its existence of about fourteen days. At the end of this time the larva spins a cocoon within which it changes to a pupa, the change taking approximately a fortnight.

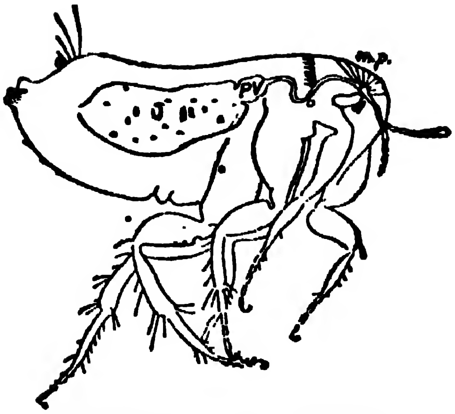
The cocoon is important, for it is at this stage of its development that the flea is most vulnerable to attack. While in the cocoon the insect may remain inactive for lengthy periods—if left undisturbed it may survive unfed for upwards of two years. At the same time it is extraordinarily sensitive to any mechanical disturbance, the slightest vibration causing the flea inside to "wake up" and emerge. This fact explains the phenomenon of a swarm of fleas suddenly appearing in a deserted house, etc., the fleas coming out of the cracks and dust in which the cocoons were lying, having been disturbed by the vibration caused by a person treading on the floor.

The newly-emerged flea is fat and can exist for some time without food. The female, as soon as she is ready to lay fertile eggs, must, like the mosquito, have a meal of blood before she can do so.

Adult Habits.

Rarely do fleas change their "host" (animal, etc., on which they live) until or unless the animal dies, when, finding their surroundings becoming too cool for their comfort, they decide to seek another home. They cannot progress easily by walking on smooth surfaces and therefore prefer to move by jumping. Their powers for this are considerable in relation to their size, but have been much exaggerated, for it has been proved by observation that the greatest height attained is seven and three-quarter inches, the usual height not more than four (equivalent to a man leaping over St. Paul's Cathedral), while the greatest horizontal distance is limited to thirteen inches (equivalent to a long-jump of 300 yards by a six-foot man). The fact that a flea shams death when disturbed is probably well known.

The adult shuns daylight—indeed, strong sunlight is fatal, as it is at all stages of development. If placed on a surface of fur or feathers it will promptly bury itself therein. The female may lay up to 450 eggs during

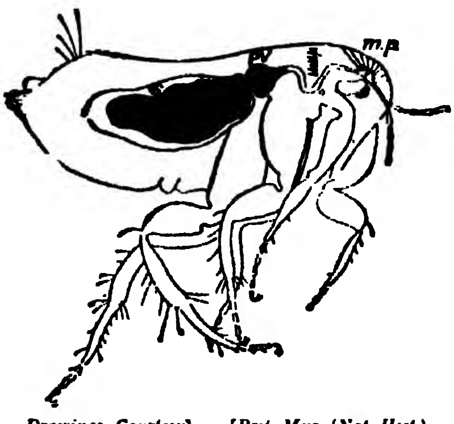


HOW THE FLEA CARRIES PLAGUE—I.

An infected flea with colonies of plague bacilli in the stomach.

her span of life, which in the human flea may extend to as long as 513 days on the natural host. Even if starved it will survive for four months in a very moist atmosphere, but cannot exist for long if it is hot and dry.

Fleas are spread in many ways. The eggs may be scattered from the person or animal carrying them: the hosts, such as rats, may be carried from place to place in ships, merchandise, and so on; clothing removed from infested persons will harbour large numbers; and, finally, when hatched in swarms too large to remain on the host, fleas will bodily migrate in search of fresh hosts.



Drawings, Courtesy] [*Brit. Mus. (Nat. Hist.), Economic Series, No. 3*

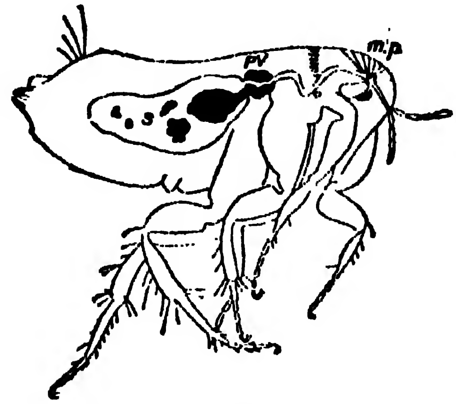
HOW THE FLEA CARRIES PLAGUE—III.

The alimentary passage is now completely blocked. Blood contaminated with bacilli is forced back into the bitten area.

Flea Prevention.

One may pick up fleas in a variety of ways—from infested persons, buildings, animals, poultry, etc., but the chief sources of them in houses are (*a*) accumulated dust and dirt; (*b*) too adjacent poultry runs, stables, etc.; and (*c*) cats, dogs, rats, and mice, the presence of which is tolerated indoors. To prevent or get rid of fleas, therefore, we must control their hosts, banish their breeding-places, destroy the fleas themselves, and, if necessary, protect our persons against them.

To effect these measures let us then, first of all, tackle the hosts. Get rid of rats and mice; take proper care of our dogs and cats,



HOW THE FLEA CARRIES PLAGUE—II.

A later stage, showing the advanced growth of the colonies.

washing them periodically with an insecticidal soap or a paraffin emulsion (hard soap 1 oz. or soft soap 1½ ozs. dissolved in half a pint of hot water; to this add gradually one quart of paraffin oil, crude or refined, stirring well; dilute one part in twenty for use); or, if there is objection to washing cats, we may treat their coats with powdered naphthalene or fresh pyrethrum powder (Keating's Powder).

In the house, keep the floors scrupulously clean, and, if fleas are actually present, pour into obvious crevices, mouse-holes, etc., a solution of naphthalene in benzene, which has the effect of rapidly killing fleas in their cocoons. (Caution is needed in the use of this on account of the risk of fire.) Another method of dealing with a floor is to scrub it with the emulsion given above. Outbuildings may be

similarly treated, the walls being washed down or sprayed with the emulsion or some creosote preparation. All rubbish, dirty straw, etc., should of course be burnt. Hydrocyanic acid gas may be used to "gas" the insects, and is very effective, especially where ceilings and roofs are infested, but it is highly dangerous and its manipulation should, therefore, be left to those accustomed to handling it.

Infested clothing, and bedding of domestic pets, can be freed from fleas either by exposure to heat or by soaking for a few seconds in the diluted emulsion referred to above. If there is really strong sunshine, such as is experienced in low latitudes, to which the articles can be exposed, it will kill the fleas in any stage of their existence, but in this country it is safer to rely on confined heat. This is easily carried out in the home by placing such articles in a cooling oven, *i.e.*, when the fire is dying down. Fleas are killed by only a few second's exposure to a temperature of 113° Fahrenheit, especially if the air is dry.

Personal Protection.

Where we have to expose ourselves to a possible infestation we may use a "repellent" such as iodoform, dusted inside the clothing. This drug, it must be admitted, has a very strong odour and if the fastidious take objection to it, they may substitute freshly powdered pyrethrum (Keating's powder), naphthalene or oil of eucalyptus. Should one have to sleep in a badly infested place where no means of exterminating the fleas are available, it is a good plan to stand the feet of beds in pans containing a little water and paraffin and draw the bed away from the wall; but take care not to allow sheets and blankets to hang loose over the edge. The bedding itself may be sprinkled with one of the repellents.

LICE

By the word "lice" we refer here only to those species infesting human beings, the other lice prevalent in Nature being in no way connected with the causation of ill-health. There are some, it is true, parasitic on other mammals which may temporarily stray on to man, but it is doubtful whether such can become parasitic on the new host.

The species infesting man take three forms. Two of these, the Head Louse and the Body Louse, differ but slightly from one another, being very closely allied if not one and the same species. The third kind is the Crab Louse. It is with the first two of these that we are concerned, the Crab Louse being relatively unimportant though by no means a desirable companion.

The chief indictment against the louse is its danger as a disease carrier. Typhus, or "jail fever" as it was called for many years in this country, is definitely known to be transmitted by the louse, not only directly by its bite, but by its excrement also, if rubbed into an abrasion of the skin. It should be noted that lice can transmit the virus hereditarily. This disease has caused appalling ravages—thus, between the years 1905 and 1911 there were 50,000 deaths from typhus in the Russian Empire; again, in Serbia during February, 1915, no less than 500 deaths occurred daily, every one due to infestation by lice.

Two other diseases can be transmitted by these insects—relapsing fever and trench fever. The latter caused an enormous amount of sickness amongst our armies during the Great War. The disease is intensely infective, it being possible for a person to become infected by receiving excremental dust on the eye membranes. The germs of bubonic plague have been found in lice feeding on plague patients.

A very great amount of disability, and even suffering, exists among the poorer classes by reason of lice, many skin troubles being initiated thereby, and being spread more quickly by the associated scratching, and probably also by flies. Imagine the condition presented by a neglected lousy head. The scalp a mass of sores and scabs; the evil smell of the sticky secretion; the hair perhaps falling out; possibly eye diseases resulting from the greatly depressed health; or even fatal blood-poisoning following widespread suppuration.

CONDITIONS WHICH FAVOUR THE LOUSE
Trench fever was widely spread during the war by the plague of lice which it was impossible to check under the wretched living conditions.

Life History.

The development of the louse is limited to two stages only—the egg and the adult—metamorphosis, then, being said to be incomplete. The egg, or nit, which is plainly visible, is attached by a cement-like substance, towards one end, to a hair of the head, body, or of the clothing. On the latter the most common sites are beneath the seams and at the neck and wrist-bands. Up to 260 eggs may be laid by one female at the rate of eight to twelve a day. With moderate warmth they hatch in from seven to ten days. The emerging adult is not full-grown for a further eleven days, during which it moults three times, and the female may commence to lay eggs the following day. The length of life is from three to five weeks—exceptionally it may attain to forty-five days—the insect feeding on blood, which it does twice daily.

The presence of lice can be easily detected, either by seeing the lice themselves or their nits affixed to hairs. The age of a nit on the head can be roughly estimated by its position on the hair if we remember that when laid it was affixed to the base of the hair. If then, the nit is some way along the hair, we can safely say that it is some days old and probably about to hatch if it has not already done so.

The number of lice on one individual may be enormous—they are usually to be reckoned in tens and hundreds, aye, and in thousands too. It is on record that, during the Great War, no less than 10,000 adult lice and as many nits were counted on one army shirt.

When lice on the head are suspected, search should be directed to the *back of the head.* Those on the body, except crab lice, are not usually seen unless the clothing is searched.

Lousiness is favoured by crowded accommodation, especially among "the great

Courtesy] [British Museum (Nat. Hist.)

THE INSECT MENACE IN 1491

Exterminating the head louse in the middle ages.

unwashed" and those who, by force of circumstances, may go for a long time without change of clothing. Infants and elderly people, the feeble-minded and neglected invalids are thus all apt to become lousy and spread the condition to others. Dissemination is facilitated by personal contact and by contact with clothing and bedding recently used by an infested person. It may also occur by casual dropping and picking up of lice. Never, however, do lice arise spontaneously from dirt.

From what has been said it is obvious that lousiness is simply due to lack of personal hygiene, and therefore our efforts must be directed towards correcting the deficiencies in this respect. The best general method of prevention, then, is frequent change of underclothing combined with an ordinary degree of personal cleanliness—two matters which it seems almost unnecessary to mention.

Prevention and Destruction.

Where lice are present, however, strong measures must be taken. If on the head, the hair should be cut short and be thoroughly rubbed with diluted paraffin emulsion (see section on "Fleas"), and a towel then wrapped round the head which should be left thus for at least an hour, or even overnight. This kills all lice and nits. The scalp is then shampooed and carefully combed over with a close-toothed comb (special combs for this purpose being available in the market) to remove the dead lice and adherent nits. The removal of the latter is facilitated by a previous application of dilute acetic acid (vinegar). Thoroughness is essential, and, to prevent any possible recurrence, the process should be repeated in ten days' time unless very careful examination has failed to reveal any more lice or nits.

Lousiness of the body may be dealt with on similar lines after first shaving the hair of the infested part. The individual should be immersed in a bath of emulsion for not less than ten minutes. The thorough disinfestation of clothing and bedding is all-important and can be carried out in the home. Lice, like fleas, being easily killed by dry heat, we can place the articles in a cooling oven, *i.e.* with a dying fire). Or, if an ordinary hot flat iron is available, the articles can be ironed over, particular attention being paid to the seams which should be opened out so as to bring the hot iron into as close contact as possible. Leather articles and furs cannot, however, be dealt with in this manner owing to the destructive effect of heat on them. Instead, therefore, these can be disinfected by soaking in emulsion for not less than ten minutes, care being taken that all parts come in contact with the emulsion. As furs and hair-covered skins are apt to retain air in the interstices where lice and nits might escape, attention to this detail is very important.

Under-garments of linen or cotton can be boiled, which is always a safe and sure procedure. On removal from an infested person such articles should be dropped immediately into some such solution as 2 per cent. lysol, in which they should remain until they can be dealt with.

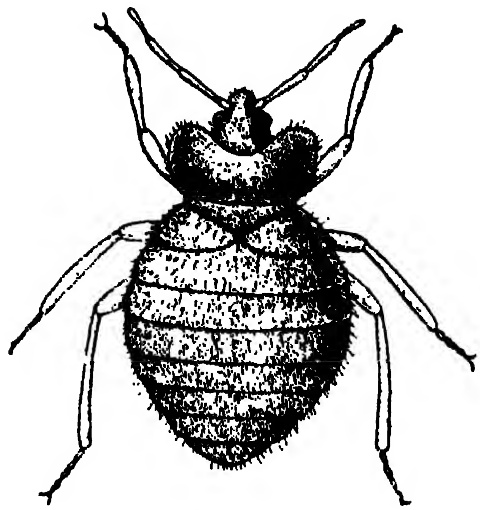
Storage with or without dusting with powdered naphthalene, is effective. The

articles should be "isolated" and, if reliance be placed on storage alone, must be kept for at least four weeks. The lice, being deprived of food, perish and the eggs either die, or, if they hatch, the emerging adults quickly die also. Packing the articles loosely in a tin box with a tightly-fitting lid and the addition of powdered naphthalene will kill off lice in twelve hours. About one ounce of naphthalene is required for each cubic foot.

Disinfestation by steam is the method *par excellence*, as it not only destroys the lice and nits, but, at the same time, *disinfects* any possible disease virus that may be present. Such a method should, of course, always be employed in the presence of louse-born disease, but its use is generally confined to those who have the requisite facilities, *e.g.* municipal authorities.

Those who have to risk exposure to possible infestation can protect themselves by freely dusting powdered naphthalene inside their clothing (taking care to have a complete change as soon as possible afterwards) and packing it loosely away with more naphthalene in a tightly closed box as previously described. Naphthalene is an insecticide, not a repellent -

Personal Protection.

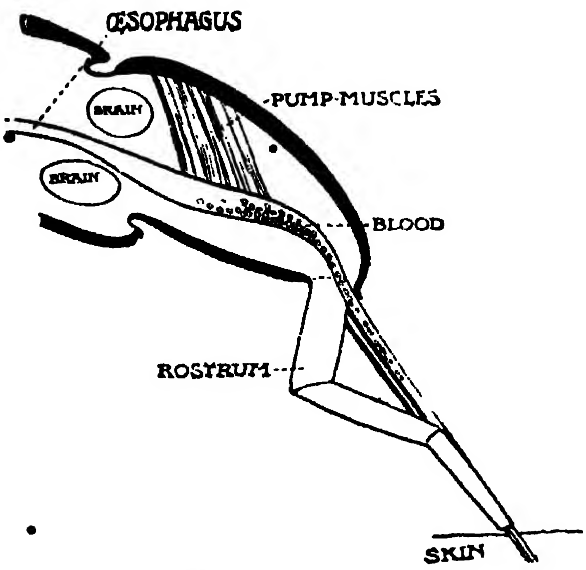


THE BED-BUG

A much enlarged drawing of the parasite which can live for a year without a meal.

in fact, there is no really effective "repellent."

In the case of those engaged in work amongst people suffering from an outbreak of louse-born disease further protection is required. It is advisable to don smooth-surfaced overalls secured round the wrists and gum-boots reaching at least to the knee, below which the overalls should extend.



HOW THE BUG FEEDS

A diagram of the head of the bug showing how it pierces the skin, sucking the blood with the help of pump muscles in the head.

BUGS

The Bed-bug (*Cimex lectularius*) is, perhaps, not quite so familiar to inhabitants of this country as is its cousin the Tropical Bug (*Cimex rotundatus*) to dwellers in warmer climes. The latter species can convey bubonic plague and is regarded as not free from suspicion of transmission of certain other diseases. Our native species is by no means a welcome guest, uninvited it may be, with its noisome odour and unkind habit of disturbing our sleep by its bites.

As in the case of the louse, metamorphosis, or mode of development, is incomplete, the adult emerging directly from the egg. The female deposits her eggs in crevices, especially of woodwork, cementing them to the surfaces with a sticky substance. The eggs are hatched in one to three weeks, a young immature adult emerging which takes several weeks, and

Life History.

even many months, to become fully grown, moulting five times during the process. The need for a blood-feed appears early, for the young bug must have such before each moult.

The mature adult is dark brown in colour and about one-eighth of an inch in length. It is exceedingly flattened so that it can penetrate into the smallest cracks. Being rather shy individuals, the bugs take full advantage of this provision of nature and hide themselves away from daylight and bright artificial light. Both sexes are blood-feeders, and sally forth from their hiding-places at night in search of their victims. Favourite haunts are in mattresses, in chinks in all kinds of woodwork, such as flooring, wainscoting, skirtings and panels supporting hat and coat racks on walls.

The bug can starve for a year and will travel considerable distances to and fro for each feed. It is on record that a certain bug actually travelled fifty yards each way for its weekly repast, progressing along gutters from a neighbouring empty house. Their journeys are not always so laborious —at least, not in the outward direction— for they are said even to drop from ceilings on to their victims. As they cannot fly, however, one can only suppose that they must return to their roost on foot. Their attentions are not entirely confined to humans, being directed also to dogs, cats, rats, mice and poultry ; but, on the other hand, they do not have it all their own way, for they are preyed on by mice, cockroaches and ants, all of which are themselves enemies of man but can here do him some slight good turn.

As bugs are so shy and retiring, it is possible only to attack them in their crevices

Destruction.

by day, or endeavour to trap them on emergence by night.

Careful observation will reveal their hiding-places which, when found, can be proceeded against. A very good way, provided there is no risk of fire, is to " flame " infested cracks with a painter's blow-lamp and follow this up by working in some diluted paraffin emulsion (see section on "Fleas"). Floors, and woodwork generally, should be scrubbed over with this. It is hopeless to attempt any treatment of infested mattresses, short of proper steam disinfection ; it is really best to burn them and cut the loss. Gassing with hydrocyanic acid gas is very effective but is far too dangerous for use save by experts.

Adult bugs may be trapped, using oneself as the bait, by standing the feet of beds in shallow pans of water, or, preferably, paraffin oil. Another method is to smear a narrow band of " tangle-foot " on the legs of the beds and around infested crevices generally. Coconut oil, smeared over the hiding-places, is reputed to be most effective in killing the bugs.

The disturbance of sleep due to the irritation set up by the bites of these pests

Personal Protection.

is in itself sufficient warrant for endeavouring to ward them off. As they have such an offensive odour of their own, deterrents are generally ineffective, though iodoform and naphthalene may be tried. It is also said that keeping a *bright* light burning in a room at night will confine them to their hiding-places.

COCKROACHES

Cockroaches, or Black Beetles, are one of the most ubiquitous of pests. They are dangerous because of their opportunities for crawling over the food we eat, in conjunction with the fact that they have been found to carry disease germs both on their feet and in their intestines. They also harbour a certain stage of some tapeworms.

Metamorphosis or developmental change is incomplete, there being no maggot and

Life History.

chrysalis stage. The female deposits her batches of eggs, sixteen at a time, in a curious brown pouch or " egg-purse," as it is called, which is carried about with her until a suitable warm crevice is found, where it may be left to hatch. From this nursery the young cockroaches, whitish in colour and somewhat like their parent in shape, emerge and wander off to feed on whatever food is available.

Growth proceeds by a series of moults,

after each of which the young insects become larger, darker, and more like their parents. When the last skin is thrown off they appear as full-grown adult cockroaches, and live for several years. The growing stage occupies from six months upwards, according to the conditions obtaining.

During all this period the insects have been feeding continuously, issuing from their hiding-places behind stoves, fixtures, skirting-boards, and detached wallpaper as soon as darkness comes, and often discharging from their mouths quantities of the odoriferous fluid which too often taints the food to which they have gained access, and invariably causes their presence to be accompanied by a disgusting odour. The fact that they will eat fermented garbage as well as clean food in the larder, and that they frequent such unsavoury places as cesspits and drain manholes, emphasises the danger of contamination and the possibility of transmission of disease germs.

Destruction

The efficient control of these disagreeable insects can only be accomplished by exercising the most scrupulous cleanliness in situations where they are likely to occur, and following systematic hygiene in regard to all stores that may attract them. In a place where they have been long established the only radical measure is fumigation with a toxic gas, such as hydrocyanic acid, cyanogen chloride, both highly dangerous, or sulphur dioxide; when the trouble is behind stoves a very useful eliminator is carbon tetrachloride spray. This must, however, be most carefully used and not inhaled, especially if the stove be hot.

After treatment, all decaying wall-surfaces, boarding and floorage must be repaired or renewed. In the case of ordinary dwellings where cockroaches are found persistently to congregate behind the wallpaper, the best plan is to remove the wallpaper altogether and use coloured distemper until the pest has vanished. Wooden floors and skirtings which afford retreats can be made untenable by the simple process of sprinkling and working into the crevices a mixture of equal parts of castor sugar and borax, or a powder composed of sodium fluoride ten parts, ground rice eight parts and calcium phosphate two parts. They may be poisoned by sprinkling on shelves and haunts a mixture of castor or icing sugar with plaster of Paris, equal

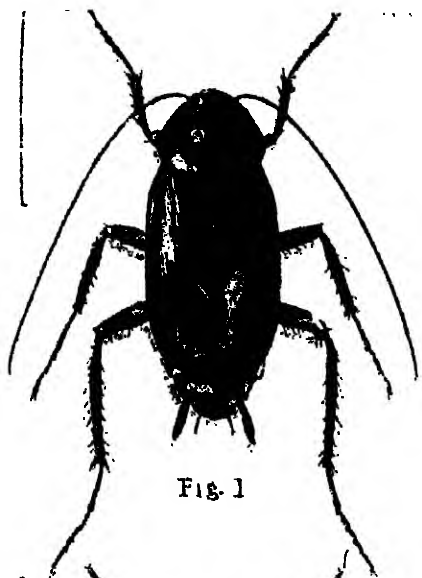


Fig. 1

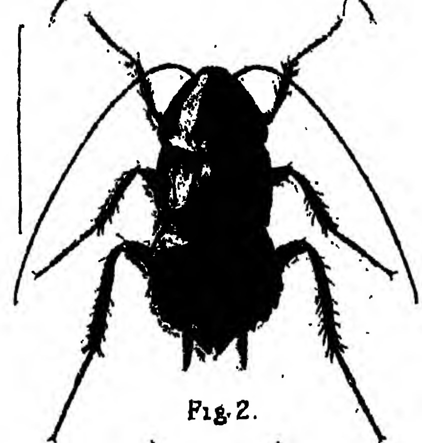


Fig. 2.

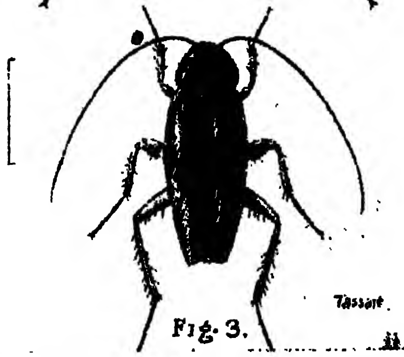
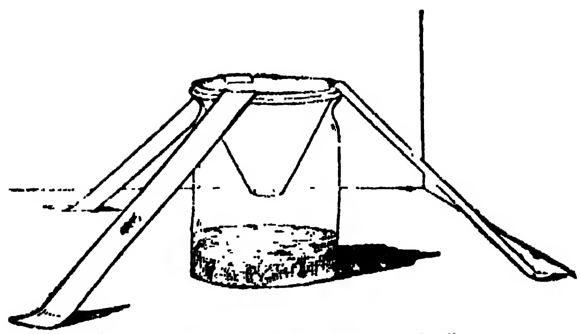


Fig. 3.

Courtesy] [*Brit. Mus. (Nat. Hist.), Economic Series, No. 12*

COCKROACHES

The two species of cockroaches commonly found in houses in this country: Figs. 1 and 2, the common or oriental cockroach, male and female; Fig. 3, the German cockroach.



Courtesy] [" *Home I nd Their Destruction*," *J. S. Bainbridge* (*Heinemann*)

A TRAP FOR COCKROACHES

A jam jar with stale beer as the bait, a paper funnel, and wooden or card runways.

parts, and at the same time placing water available for drinking.

Among their natural enemies are cats, hedgehogs and rats. An effective trap is a jar partially filled with stale beer and having a number of sticks or cardboard runways laid against the rim and bent inwards so as to project over the interior.

Another trap, improvised from an empty tin, the insides and bottom of which are smeared with rancid butter, will catch large numbers; the cockroach, attracted by the bait, cannot climb up the greasy sides once it has got in. The "Demon" trap, which is probably well known, is also very useful in exterminating these pests.

HOME DISINFECTION AND SANITATION

By ELIZABETH EDWARDS (Good-Housekeeping Institute); King's College Certificate of Household and Social Science; Certificate of the London Sanitary Board.

HYGIENE is an applied science dealing essentially with the preservation of health. As all are aware, perfect health depends upon an innumerable number of factors. It depends on correct diet, suitable clothing, sunlight, plenty of fresh air, etc., while in addition the human body is constantly in conflict with numbers of micro-organisms or germs. The latter are so small that they cannot be seen by the naked eye, and even when seen under the high power of the microscope their size is very minute.

Although many germs are quite harmless, the fact that some are definitely harmful in some way or another makes it most desirable to know of effective methods of killing and destroying them. This is specially the case when one remembers that many diseases are of microbial origin, the microbes entering the body in various ways, such as through the nose or mouth, as in the case of most infectious diseases.

Exposure to considerable heat is an effective way of killing germs, but in many cases this is not practicable, and resort is then made as a rule to chemical substances known as disinfectants. Chemically these are very varied, but one and all, in order to be truly classified as disinfectants, they will kill germs if the strength of solution used is suitable.

Many people make the mistake of imagining that antiseptics and deodorants are identical, or practically identical, with disinfectants. This is erroneous, however, for an antiseptic may only prevent the growth of germs, not necessarily killing them. Deodorants are essentially substances having a fairly strong odour which is sufficiently penetrating to mask another unpleasant odour. These are, on the whole, undesirable, for their use frequently leaves a false feeling of security, and the real cause of the trouble is not investigated and remedied.

Chemical disinfectants are many and varied, including derivatives of coal tar, such as carbolic acid and similar substances, various chlorine products, the salts of certain metals, etc., while in addition there are a large number of efficient proprietary disinfectants on the market.

As well as chemical disinfectants one must not forget the cheapest, which include exposure to sunlight, fresh air and heat, saturated steam being specially efficient.

Various properties are required of the ideal disinfectant: in the first place it should be cheap, so that it may be within the reach

of every one's purse. It should be non-staining and non-corrosive, or otherwise its sphere of usefulness will be strictly limited. Other desirable points are that it should be as far as possible non-poisonous, while its germ-killing power should obviously be high.

When carrying out home disinfection, it is worth remembering that all disinfectants are more active when hot, and therefore it is a good plan to dilute the disinfectant with hot water, while another point worth remembering is that disinfection, although rapid in the case of an efficient disinfectant, is not absolutely instantaneous. Consequently, when clothes, etc., are being disinfected after an illness, they should be allowed to soak in the disinfectant solution for a short time.

The majority of people make the mistake of only associating the use of disinfectants with an illness. Although naturally of the greatest value under such circumstances, this is unnecessarily limiting their usefulness. Every household might, with advantage, use disinfectants to a far greater extent than is usually the case. It should be made a rule in every house to flush the sink and drains occasionally with a disinfectant solution, while the addition of a little disinfectant to the water used for scrubbing floors, etc., is very desirable, and helps to ensure hygienic cleanliness.

After a serious and notifiable infectious illness, the local sanitary authorities usually undertake the necessary disinfecting, and it is of course wiser to entrust the work to them, for they possess the necessary sprays, and so on. There are other occasions, however, when the housewife may wish to disinfect a room, or perhaps sheets, clothes, etc., and general directions for the method to be adopted are therefore given in the hope that they may prove useful.

After Infectious Illness.

Bed linen, hangings, and anything which can be disinfected with the clothing, should be placed in a bath of disinfectant of a suitable strength. In the case of proprietary disinfectants the required dilution is usually stated very clearly, and the directions given should be followed. The windows and other openings should be shut and blocked up, the door being left unlocked. The room should then be fumigated, either by burning a sulphur candle or by generating formaldehyde from paraform. The exit door should be pasted over for twenty-four hours, after which the doors and windows should be opened and the room ventilated as thoroughly as possible.

During the course of an infectious illness a disinfectant bath should be kept in the sick room and all articles of clothing immersed in it as soon as they are discarded. After disinfecting, the clothes should be washed, and, if of white cotton or linen, boiled and finished in the usual way.

Coming to other practical aspects of the subject, the cleansing of drains, water-closet pans, gullies, and waste pipes requires special care and attention. It is a good habit to use disinfectants systematically throughout the year, utilising them more frequently through the summer months. Certain sanitary appliances and fittings are to be found in every house, and unless the house is old-fashioned these appliances are simple and effective in removing waste water and excreta from the premises to the house drain and eventually to the sewer. It will be obvious that as waste matter of any kind putrefies rapidly, giving off an unpleasant odour, and in some cases contains harmful bacteria, it is desirable to remove it rapidly and efficiently.

Sanitary Appliances.

Courtesy] [Uni Hygea, Ltd.

A HYGIENIC DISINFECTOR

A disinfecting attachment which can be easily fitted to the flush pipe of a water closet.

The sanitary appliances are to be found in the lavatory, bathroom, and kitchen. The most

[*Int. Graphic Press*

DISINFECTION AFTER INFECTIOUS ILLNESS
The room has been fumigated, with windows and doors pasted over, and left for 24 hours. When entering the room to open the windows, eyes and nose should be protected from the fumes.

suitable materials for their construction are glazed fireclay and enamelled porcelain. These are non-porous, thus odours and materials are not absorbed. The smoothness of the surface also aids thorough cleansing.

The local building bye-laws, for reasons of health, insist that water-closets must be on an outside wall and must be provided with a window. This arrangement minimises the length of soil pipe required. Having controlled the drainage and fittings, the sanitary authority cannot do any more, and it rests with the householder to keep these fittings in a hygienic condition. Modern invention supplies a special disinfecting attachment which can be easily fitted to the flush pipe leading from the waste water preventer in the water closet. Its action is automatic, and while the ordinary flush is passing, the disinfector fills with water, which dissolves a small portion of the disinfectant. This water, charged with disinfectant, comes down with the final volume of water and is thus retained in the pan. Such appliances require no attention beyond re-charging with disinfectant, and are well worth the slight cost which their purchase entails.

Adequate ventilation and good lighting are of the utmost importance, as a constant stream of fresh air through the apartment obviates any unpleasant smell.

The waste pipes from the bath, sink, and lavatory basins are fitted with a U-shaped trap, the object of which is to prevent sewer gas from entering the house. This is brought about as follows : The trap is so arranged that water can never leave it, as it is held in the bend of the pipe. Water is relatively impervious to gas and whereas the gas could travel unimpeded through an open pipe the water acts as an effectual check.

It is essential that these traps should be kept in perfect condition, and if ordinary care is taken to prevent stoppage, clean water will be left in the trap every time the bath, basin, or sink has been used and rinsed.

The sink trap is often a source of trouble when pieces of food and large amounts of grease are allowed to go down the waste pipe. This condition can be obviated by using a sink basket, and also by keeping the loose perforated disk on the waste pipe.

When a good deal of greasy water must of necessity be poured down the sink, and when the water is hard, soda and boiling water should be used freely at least once a day. The soda solution emulsifies the grease, thus aiding in its removal. Flushing with very hot or even boiling water is then required to remove this.

" THE SICK LADY "

From the famous painting by Jan Steen—a typical example of unhygienic sick nursing.

XVI
CARE OF THE INVALID
HOME NURSING

By ROSE BLAND, S.R.N. (formerly Matron of the Canning Town Women's Settlement Hospital).

IT is usual, when giving instruction on Home Nursing, to begin by enumerating all the attributes which a nurse should possess. It is sufficient here to say that the nurse, or whoever may be acting her part, is responsible for the patient's well-being, and for the carrying out of the doctor's instructions. She must be absolutely loyal to the doctor in every way, and all orders must be faithfully dealt with, both in letter and spirit. In a serious illness, very often half the battle is won if the patient has implicit faith in his doctor, and therefore, by no word, sign or suggestion must the nurse disturb the patient's confidence in his medical adviser. She must also be loyal to her patient. When a person is ill and in pain he may act differently from what he would do if well; he is weak, and therefore has not the same control over himself. All irritability and difficult behaviour on his part must be met with kindly patience and a sympathetic understanding by the nurse. Annoyances must be immediately forgotten, and never repeated to some one else. If the nurse has the full confidence of both the doctor and her patient, her trying work will lose many of its difficulties, and will bring its own reward. She who lacks the confidence of either had much better give up her work, for she will probably do more harm than good.

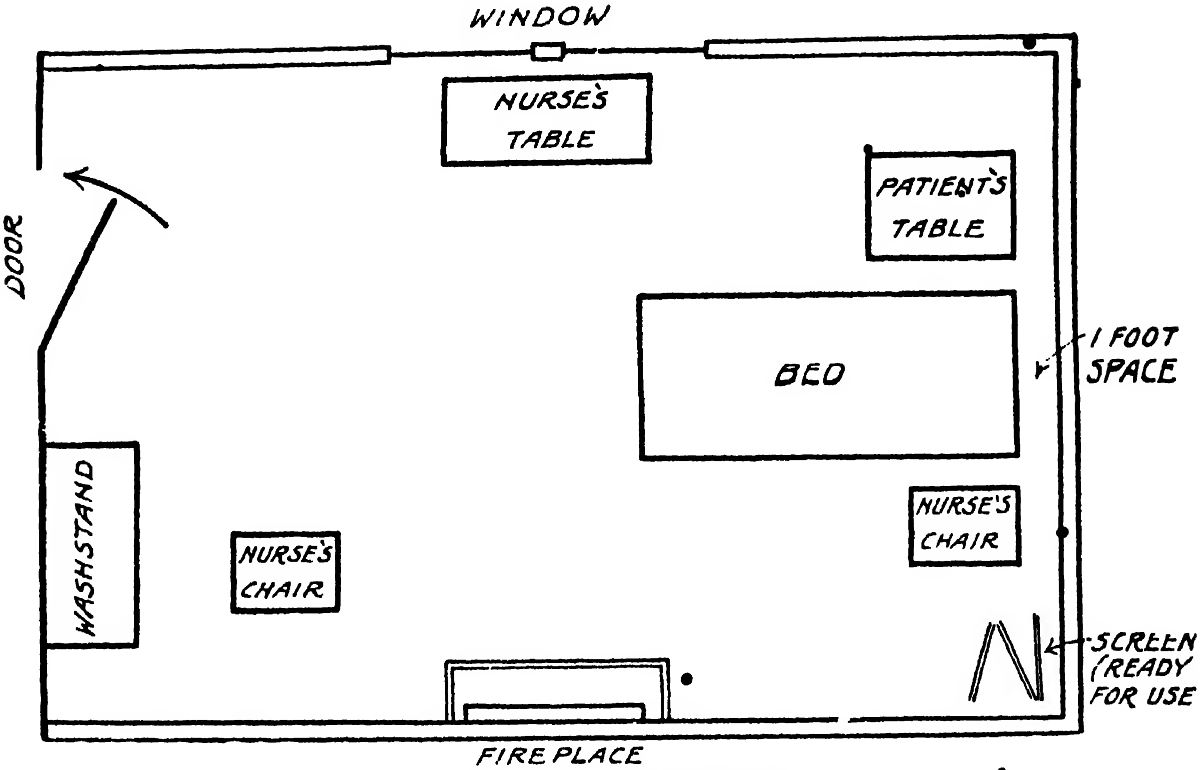
ROSE BLAND, S.R.N.

When a sick person has to be nursed in the home, the first consideration should be given to the choice of room, granted there is a choice. It should be as large and as airy as possible, and with adequate cross-ventilation. Quietness is an absolute essential, both with regard to outdoor noises, traffic, etc., and to indoor, domestic noises. Very often the latter are far more trying to an invalid than are the former.

The Sick Room.

There should not be more FURNITURE than is really necessary. Big, heavy pieces of furniture take up a definite amount of air space, and should therefore be dispensed with. Two small tables should be in use, one by the side of the bed for the convenience of the patient, and the other away from the bed for the nurse's use. There should be a chair for a visitor, and a comfortable one for the nurse. A wash-hand stand for all the washing requisites is required, and, if this has a cupboard underneath, it is convenient for holding all lotions, disinfectants, etc. All heavy curtains, hangings, etc., should be removed, and light, washable ones put in their place.

The FLOOR should not be entirely covered with carpet. It is much better to have a covering of linoleum, or plain polished boards, and small rugs placed where there is most traffic, so that the necessary walking about does not disturb the patient



A PLAN OF THE SICKROOM

Only necessary furniture should be allowed in the sickroom; the bed must be out of all draughts, though good cross ventilation is essential.

For adequate VENTILATION, the window must be in a workable condition. If it is a sash window, it should open both at the top and bottom. If it is a casement one, the iron rod which regulates the opening should be long enough to allow the window to open quite wide, to the full width of the frame. The window of a sick room must always be open, and, except in very stormy weather, quite wide open, for the wider it is the less draught will be felt. If the weather is very rough, the opening of the casement window can be regulated by the rod, whilst in regard to the sash window the top half should be closed, and the lower half raised from four to six inches. A piece of wood of that depth and of the same width as the window should be placed in the frame, and the lower half shut down on to it. This means that the lower sash is lifted from four to six inches, and will provide an inlet for fresh air. An open fireplace or a modern gas stove that has a ventilation opening at the back will make the necessary cross-ventilation. Under these conditions, it will be necessary to give the room a more thorough ventilating two or three times a day. To do this, the patient should first be well covered with warm clothes, and, if advisable, protected by a screen, then the doors and windows thrown wide open for five minutes. Such ventilation is necessary for the health of both patient and nurse, and is often found to be most soothing in its effect on a tired and restless sufferer. An effective emergency screen can be made by covering a two or three-fold clothes-horse with a large sheet or blanket.

The TEMPERATURE OF THE SICK ROOM should be kept at about 60° Fahrenheit, though quite young children and very old people will probably require it up to 65°. Sometimes persons suffering from chest illnesses, particularly the young and the old, require a higher temperature, 65° to 70°. Such a temperature is very trying to the nurse, so that she should take every opportunity when "off duty" of getting out into a cooler

atmosphere. The temperature should never be a matter of guess-work. A thermometer should be placed on the wall near to the bed, and away from both fire and window.

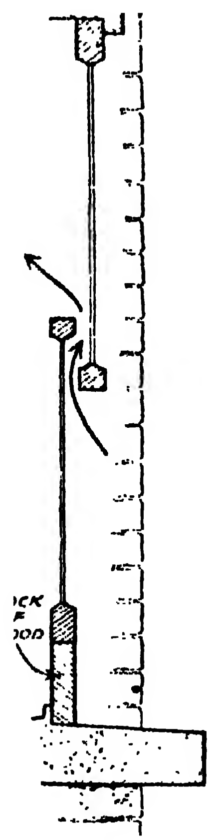
CLEANLINESS is essential in the sick-room, whatever the disease may be from which the patient is suffering. The greatest care must be exercised when cleaning the room not to raise the dust. The rugs must be cleaned with a vacuum cleaner, or else taken out of the room and well shaken. In cases of infectious disease no rugs of any kind must be allowed. The floor should be rubbed with a duster that has been either wrung out of a weak Lysol solution (one teaspoonful of Lysol to one pint of water) or smeared with furniture polish. In either case, the dust will stick to the duster, which should be washed immediately after use, when dust, dirt, and germs will promptly go down the drain.

A single BED is best, both for the comfort of the patient and convenience of the nurse. It should be so placed that she can get all round it. The head should be from twelve to eighteen inches away from the wall, and there should be access to both sides. This not only makes the nursing easier, but gives the patient a feeling of space and freedom that he does not get when his bed is pushed close to the wall, or fixed in a corner of the room. The bed must not be placed at an angle between the window and the fire-place; whilst good ventilation is essential, direct draughts must be avoided.

The bed-clothes must be as warm as possible in cold weather, as few as possible in hot weather, and always—in summer and winter—as light in weight as can be managed. Heavy bed-clothes are very tiring to a sick person. New blankets are warmer than old ones, so that fewer are needed, whilst an eiderdown quilt is warmer and lighter than several blankets. The counterpane, or bed-spread, serves two purposes; it protects the blankets from dust, and it is a decorative covering; as it is not necessary for warmth it should be light in weight.

In many illnesses it is necessary to put a blanket next to the patient. This must be scrupulously clean and changed frequently, otherwise it is apt to become unpleasant. It is wise to have two blankets for this purpose, so that whilst one is in use the other can be aired in the open. The frequent substituting of a cool blanket for a hot one makes a great deal of difference to the comfort of the patient.

The sheets, especially the bottom one, should be much larger than the bed, so that they can be securely tucked in all round. If the bottom sheet is not firmly tucked under the mattress, the patient in his restlessness will quickly get it creased, and add greatly to his discomfort. If he is unable to get out of bed a draw-sheet and mackintosh are essential. The rubber mackintosh, which is placed across the bed, should be wide enough to reach from the bottom of the pillows to the patient's knees roughly about two and a half feet wide—and long enough to go from side to side of the mattress, *i.e.* about three and a half feet long for a single bed. To each end should be stitched a piece of strong, unbleached calico the width of the mackintosh and about eighteen inches long. These calico ends can be firmly tucked under the mattress, so making the mackintosh secure, and preventing it from getting creased. For a drawsheet, an ordinary sheet can be doubled lengthwise, making a long, narrow sheet. This is put across the bed over the mackintosh, leaving one end very much longer



FRESH AIR IN STORMY WEATHER
A sash window can be shut down on to a block of wood the width of the window, to allow air to enter between the sashes.

MAKING THE BED

Showing how the mackintosh and draw-sheet are pulled tight after all the upper bed clothes, except a blanket, have been removed.

than the other; the short end is tucked under the mattress, and the long one is first rolled up tightly before being also tucked under. If the patient is likely to be confined to bed for a lengthy period it will be found more economical to make proper draw-sheets. For this purpose soft, unbleached sheeting is the best, and the sheets, when made, should measure a yard wide and three yards long.

Bed-making.

The making of a sick bed is an art; how much an art only those can tell who have been a fixture in one for some time. If possible, the nurse should have some one to assist her to make the bed of a helpless patient. But whether she is working alone, or is able to obtain help, the routine is the same. A patient who is so ill as to be unable to leave his bed must have that bed *made* twice daily—a mere straightening of the bed-clothes is not sufficient. In order to do this efficiently, and with the least disturbance of the patient, the procedure should be as follows:—

A chair should be placed at the foot of the bed, and the clothes taken off singly and placed on it. These must not be dragged off, but folded, by turning the top hem to the bottom, and gently lifting them off the bed. The patient should not be left completely uncovered, and a sheet or blanket must be left over him. The remaining bed-clothes should then be loosed all round the bed, and the bottom sheet pulled firmly and tucked in tightly so that there are no creases under the patient; the mackintosh should be pulled tightly also, and the ends tucked in; the draw-sheet is then unrolled from the long end of the roll to about the width of the bed, and the remaining end tucked quite securely under the mattress. If the nurse has an assistant, she should then gently raise the patient whilst her assistant draws the sheet through, rolls up the end and tucks it firmly under the mattress. This firm stretching of the draw-sheet, so that

CHANGING THE SHEET

The sheet is untucked all round and rolled up lengthwise close to the patient's back; the clean sheet is then put on this half of the bed before moving the patient over.

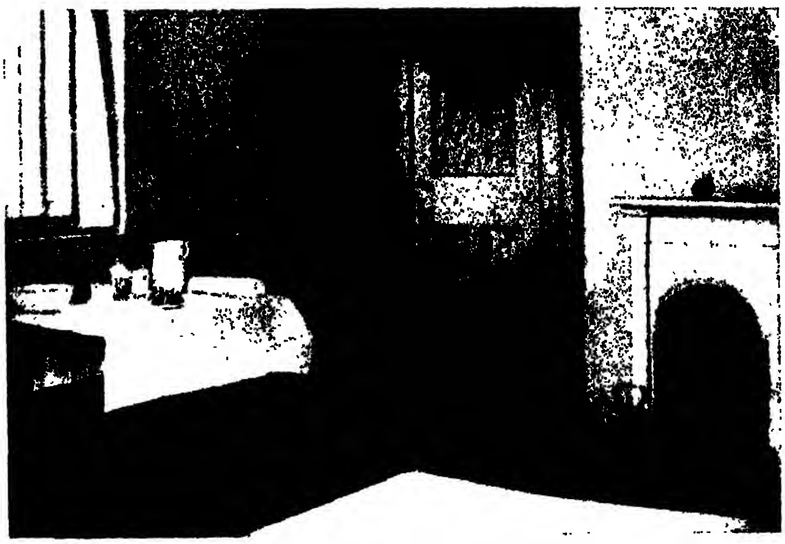
there are no creases to cause friction, lessens the risk of bed-sores. If it does not inconvenience the patient, all his pillows except one should be removed while the bed is being made, for this facilitates the straightening of the sheets under him. If, however, he cannot lie with his head low, he must be supported while the pillows are taken out, well shaken, and replaced with the cool side uppermost.

A LESSON IN BED-MAKING
Nurses learning how to care for sick patients. In serious cases it is easier for the nurse to have a helper when making the bed.

A patient who is propped up with pillows, or with a bed-rest, should have a firm pillow under his knees, in order to prevent him from slipping down the bed. This "knee-pillow" should be rolled in a sheet, placed in position, and the ends of the sheet tucked under the mattress. After this has been done the top sheet and blankets are replaced, care being taken to tuck them in firmly at the foot of the bed.

In order to put a clean bottom sheet on the bed, the draw-sheet and mackintosh are removed, and the patient turned gently on to his side. The sheet is loosened all round and rolled neatly and firmly lengthwise up to the middle of the bed, and close to the patient's back. The clean sheet also is rolled lengthwise for half its width, and the roll placed on the bed alongside the rolled soiled sheet; the remaining half is spread over the half of the bed, and firmly tucked under the head, sides, and foot of the mattress. The patient should then be gently rolled over on the clean half of the sheet; the soiled sheet is quickly taken off the bed, and the clean sheet unrolled and tightly tucked in all round. The mackintosh and draw-sheet are then put on in the way previously described.

If, for any reason, the patient cannot be turned on to his side, the clean sheet must be put on in a similar manner, but from the *top* of the bed instead of from the side. The nurse must have help in order to do this. The pillows are removed and the patient supported by one nurse while the other

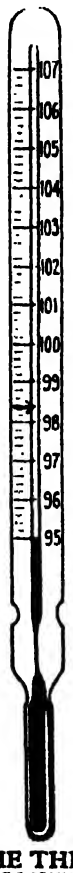


A CORNER OF THE SICKROOM
Showing the nurse's table, the open window and gas fire-place providing cross ventilation, the clock, thermometer and gas-ring.

quickly, but *gently*, rolls the soiled sheet from the top of the bed to the patient's back. The clean sheet should be tucked in at the head of the mattress, then spread down the bed, and the lower end rolled tightly to meet the roll of the soiled sheet. The pillows should then be replaced, and the patient put back to rest on them. One nurse should then gently raise his back, supporting him firmly, whilst the other deftly draws first the soiled sheet downwards, and then the clean one. At the foot of the bed the soiled sheet is removed, and the clean one firmly tucked in. When changing the sheets of a sick bed great care must be exercised not to hurry the patient, and to move him no more than is absolutely necessary.

Patient's Clothes.

The patient's shirt or gown should be made of a warm material that is light in weight, and of such a pattern that it can be put on and taken off with the least possible disturbance of its wearer. In cases of heart disease, acute rheumatism, and other diseases in which all movement on the part of the patient is to be avoided, short gowns that are open right down the back should be worn. These can be put on or off without undue movement.



THE THERMOMETER
The normal temperature is 98.4° (arrow.) Shake the quicksilver down to 95° before using.

THE ROUTINE OF NURSING

Taking the Temperature.

The normal temperature of the human body is 98.4° Fahrenheit. Any great variation from this denotes ill-health. Care is needed to take an accurate temperature. The thermometer should be shaken until the quicksilver goes down to 95°, and then the bulb placed under the patient's arm or tongue; in the case of a child, in the groin or the rectum. After use, the thermometer should be dipped into cold water (not hot, as there is the risk of breaking it), and wiped with a clean cloth; or better still, it can be kept standing in a small glass or jar in a weak solution of Lysol, with the bulb resting on a piece of cotton wool at the bottom of the jar.

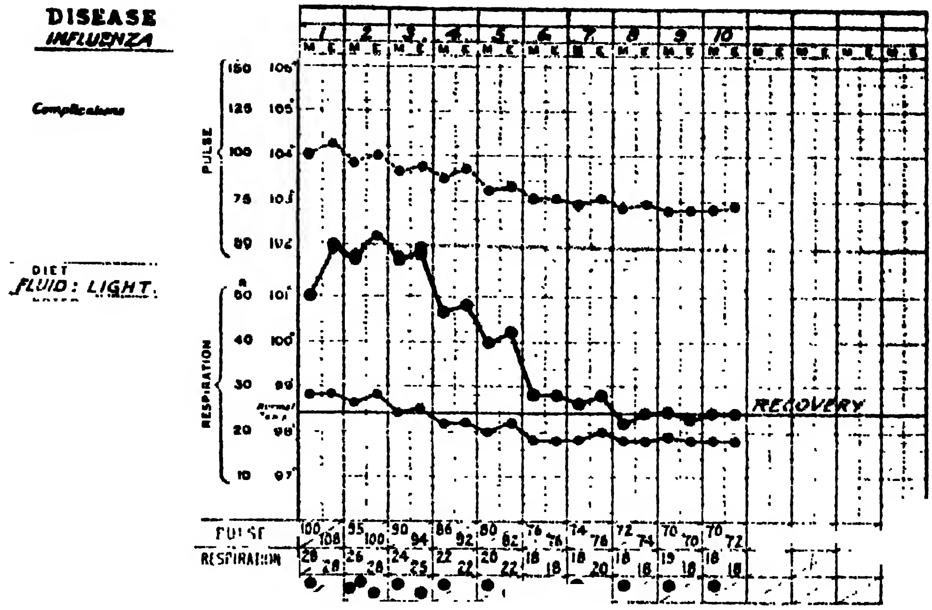
Before the thermometer is placed under the arm or in the groin the patient's skin should be wiped with a towel. If placed in the rectum, the bulb should first be smeared with a little vaseline.

The temperature must always be taken in the same part of the body, not at one time in the mouth and at another under the arm, as there is a slight variation in the different parts—that taken in the mouth and rectum being slightly higher than that in the armpit or groin. An accurate temperature is not likely to be registered in either of the latter places if the patient is emaciated. It should not be taken in the mouth of a young child, an unconscious patient, nor one that is subject to fits. It is unwise to take the temperature immediately after a meal or a hot, stimulating drink. In a very weak patient it can be raised some degrees under such conditions. It should be taken *before* the patient is bathed, not just after. The doctor will give instructions as to whether he wishes the temperature to be taken every four hours or only in the morning and evening. Usually, if it registers as much as 100° Fahrenheit, it is taken every four hours until it has reached the normal, and has remained so for forty-eight hours.

Taking the Pulse.

The normal pulse-rate of a healthy adult varies from seventy to eighty beats per minute. In young children it is quicker, while it tends to get slower in old age. Much variation from the normal suggests illness. Whilst a great deal may be learned from the quality and rhythm of the beat, which requires an experienced nurse to detect, the number of beats per minute is a satisfactory guide, and an inexperienced person can quickly train herself to count them accurately. In a serious illness, though the volume and rhythm indicate much, these rarely become altered without the rate increasing also. The pulse can be counted wherever an artery reaches

the surface of the body. It is usual to take it from the artery at the wrist, and both sides should be felt. If the patient is very ill, and the heart-beat feeble, it may be easier to count the beats at the temple, just in front of the ear, or it may even be necessary to place a hand over the heart. In taking the pulse at the wrist, the nurse should be careful to place the tips of her first and second fingers over the artery. She should not feel the pulse with her thumb, as she may mistake her own pulse for that of the patient's. When counting the pulse-rate a watch with a second-hand should be used, and the beats counted during a whole minute.



THE CHART OF DAILY PROGRESS

A typical chart (in a case of influenza). The temperature, pulse and respiration are entered twice daily.

Respiration consists of two movements of the chest; inspiration, when air is taken into the lungs, and expiration, when air is breathed out from them. The normal respiration-rate of a healthy adult is seventeen to eighteen times per minute. In children it is quicker, while it is slightly slower in old age. The nurse should try to count the respirations without letting the patient know that she is doing so, otherwise he may not breathe naturally, and it will be difficult to count accurately. The temperature should be taken at the same time, and the nurse should have her watch in her hand and count the respirations. If the patient is of a nervous temperament and does not breathe naturally, the respiration-rate should be counted while he is sleeping. A *chart* should be kept, and the temperature, pulse and respirations accurately recorded, either four-hourly or twice daily. They should be marked down as soon as they are taken, so that they are not forgotten. If the patient has a high temperature and it is not wise for him to see the chart, this should be kept outside the sick room, so that he does not know of its existence. It is very disturbing to a sick person to know that a chart is being kept and that he is not allowed to see it, and a good nurse will avoid doing anything that will worry her patient and cause him anxiety.

Respiration.

If the patient is too ill to leave his bed he must have a "blanket bath." This must be carefully and methodically given, otherwise the invalid, instead of being refreshed, will be tired and exhausted. A clean gown should be got ready, and in cold weather should be warmed in front of the fire. A bowl of hot water, soap, two wash-flannels, two towels, powder, methylated spirit, a tumbler of warm water, and a small bowl should all be got in readiness before disturbing the patient. The window should be closed, and the hot bottle refilled and put at the patient's feet. The bed-clothes are then removed, with the exception of a covering blanket and another underneath him. The teeth should first be cleansed. If the patient is able, he should

Baths.

TAKING THE TEMPERATURE AND PULSE
The mouth is the most usual place to take the temperature in a conscious adult patient. The normal pulse rate is from 70 to 80 beats a minute.

be allowed to do this himself, the nurse holding the tumbler and the small bowl, so that he can use them without undue exertion. If he be too ill to do this, the nurse should put some cotton-wool dipped in borax and glycerine round her finger, or on the end of a pair of forceps, and gently clean both teeth and tongue. In serious illness frequent cleansing of the mouth is necessary. The nurse should then proceed to wash the patient, beginning with the face; then one arm is taken from under the blanket, the towel spread beneath it, the limb washed and dried, and then quickly covered again with the blanket. The other arm is done in the same way, and then the chest, and then the lower limbs, separately, as in the case of the arms. After this, the patient, covered with the blanket, is gently rolled on to his side, and his back washed.

The lower part of the back should be washed with the second flannel which is kept for this purpose. After the back has been well washed, and before it is dried, the nurse should soap her hand and gently massage the back, especially the bony prominence of the spine, using a gentle rotating movement, in order to encourage the circulation of the blood where it has been impeded by constant pressure on the bed. The skin should be dried thoroughly, without rinsing off the soap, which helps to harden the skin. In drying, the skin should simply be dabbed with a soft towel, and *not* rubbed. Rubbing with the fingers and with a towel are two different things; the former stimulates the tender skin, the latter may be too rough and tend to break it. On no account must this happen, or a bed-sore will be the result. This is a serious complication in any illness, adding very greatly to the distress of the patient and to the work of the nurse, on

To Prevent Bedsores.

PREVENTING BEDSORES IN A SERIOUS ILLNESS
After washing and carefully drying, the back and buttocks should be gently massaged with methylated spirit; zinc and boracic powder is then applied.

whose capabilities it would cast grave doubts. When dried, the skin should again be gently massaged with methylated spirit, and zinc and boracic powder applied. The patient should then be turned gently on to his back once more, and a clean shirt put on.

PUTTING ON THE PATIENT'S GOWN
In a serious illness, when moving the patient is to be avoided, a gown open down the back should be used.

Whilst the nurse must be as expeditious as possible, she must be gentle and deliberate in her movements, and in no way hurry her patient during the bath. If he is very ill a complete bath at one time may be too exhausting for him. In this case, the upper part of the body, entailing the removal of the shirt, may be washed in the morning and the lower limbs in the evening, or vice versa. In any serious illness the back should be attended to at least morning and evening, oftener if necessary. Any redness of the skin is an indication that pressure must be relieved, and this can be done by placing an air-ring or cushion under the buttocks. He should not be placed directly on to the rubber surface, but the ring should be put into a pillow-case, which is kept perfectly dry and free from creases. Moisture will quickly lead to the formation of bed-sores, so that in cases where there is any incontinence extreme care is necessary. Under such conditions pads of sphagnum moss, which is very absorbent, should be made and put under the patient. Since bed-sores are so serious a condition, all redness of the skin on any part of the body should at once be reported to the doctor, remembering that prevention is much easier than cure. Where there is incontinence, an ointment made up of 2 oz. of white lard, 1 teaspoonful of Friar's Balsam and 1 teaspoonful of castor oil should be used in place of the methylated spirit and powder.

If the patient is well enough to go to the bath, care must be taken to see that the water is not too hot, or he may turn faint. If he should faint while in the bath, the waste-plug must be taken out at once. A bath thermometer is required to test the temperature, as it cannot be told accurately by feeling with the hand. During the reading of the thermometer the bulb must be kept in the water, as the quicksilver begins to go down as soon as it is taken out.

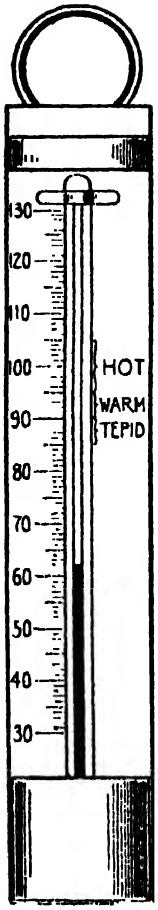
Temperature of Baths

Hot Bath -	From 95° to 105° Fahrenheit for *adults*.
	From 95° to 100° Fahrenheit for *children*.
Warm Bath -	From 90° to 95°.
Tepid Bath -	From 85° to 90°.
Cold Bath -	The water is used as it is drawn from the tap, and not artificially either warmed or cooled.

SICK ROOM DIETARY

The doctor's instructions with regard to the feeding of the patient must be accurately carried out.

"MILK ONLY" means that *only* milk may be given, and not occasionally a little custard or a little fish if the patient fancies it. Serious



THE BATH THERMOMETER
Keep the bulb in the water while reading the temperature.

results may follow the giving of solid food when *milk only* has been ordered. The popular idea that milk is a drink and not a food is entirely wrong, for milk contains all the food constituents found in solid food. Thus the nurse can assure her patient that he is having food, the only difference being that milk is fluid, whilst all other foods are solid. The patient who is not allowed any other food will require three pints of milk in the twenty-four hours, which should be given at two-hourly intervals. Five ounces should be given at each feed, unless he sleeps at night, when six ounces should be given at a time, as the feeds will be less frequent. A sleeping patient should *never* be wakened for food, for sleep is often more necessary.

"Milk only" is nearly always ordered in cases of rheumatic fever and gastric cases, and is a very monotonous diet, of which the patient quickly tires. It can be varied by giving it cold one time, and hot the next. (N.B.—In cases of ulceration of the stomach, however, *hot* drinks must not be given.) It can be diluted with barley-water or with hot water. An occasional slight flavouring of vanilla will make it more palatable for some people, especially for children, while, in hot weather, iced milk or milk and soda-water make quite refreshing drinks. A milk jelly is another useful way of giving milk. By these methods milk feeds can be varied every time, and so prevented from becoming so monotonous. It is not wise to wait until the patient has become tired of milk and then attempt to vary it; it should be varied from the beginning in the hope that he may not get a dislike for it.

"Milk only" does not exclude *water*, unless it is definitely specified. Most sick people suffer from lack of water, and would be far better if they drank more, especially when there is a high temperature, when fluid is particularly necessary. The old-fashioned idea that cold water does harm if given to a patient who is feverish is wrong. The invalid should be allowed to have as much as he wants, always provided that the water is freshly drawn and quite cold, not tepid. Exceptions to this are in such cases as dropsy, when the body cannot deal with fluid so that water and other fluids must be curtailed.

A FLUID DIET means that any kind of fluid may be given, but *no* solid food of any kind. It includes milk, bovril, home-made beef-tea, freshly-made tea and coffee, home-made lemonade, barley-water. Care must be taken to see that at least two and a half pints of milk are taken in the twenty-four hours, otherwise the patient will not have sufficient nourishment, as the other fluids, whilst stimulating, are lacking in the essential food constituents. To ensure that sufficient milk is taken both bovril and coffee can occasionally be made up with milk. The home-made beef-tea should not have milk added, for it is too greasy; if taken immediately it is made it is a stimulating and refreshing drink which requires no digesting, and is therefore quickly absorbed into the system. As previously stated, the patient should be given as much cold water as he will take.

MILK DIET includes milk, custards, milk puddings, jellies, junket and cream, blanc-manges, Benger's food, arrowroot, and Horlick's malted milk.

LIGHT DIET includes milk, tea, coffee, toast, bread and butter, eggs, soups, steamed white fish, chicken, spinach, well-boiled onions and sometimes potatoes (the last are often withheld in the early convalescence of gastric patients), and usually stewed fruit.

Method of Feeding.

If a patient cannot sit up to take his food, he must be carefully fed. The nurse must always remember that in a serious illness one of the greatest difficulties she has to contend with is that of getting the patient to take sufficient nourishment, or to be content with the nourishment prescribed for him. Consequently, a great deal depends on her. Fluids should be given in a "Sir Frederick Treves" feeder, that is, one in which the side of the feeder is curved to form a spout out of which the patient can drink. A feeder with a tea-pot spout should never be used except in an emergency; the spout is very difficult to keep clean, and a fastidious patient will be put off his food. When feeding the invalid, the nurse should put a napkin under his chin, gently raise his head and shoulders by placing her arm under his pillow, put the feeder to his lips and let him slowly drink. He must not be hurried, for if he is very weak he will find it tiring to drink; if he is suffering from some chest complaint, so that his breathing is impeded, it may be necessary to let him pause and take breath between each sip. When he has finished, his lips should be wiped with the napkin, his pillow turned the cool side uppermost, and his head put into a comfortable position. Whether all the food has been taken or not, the feeder should be removed from the room at once, and not left in the patient's sight. If for any reason he has not been able to finish his meal, he will be less inclined than ever to take the next one, if the feeder has been in front of his eyes all the time. No food of any kind must be kept in a sick room. If necessary, for the sake of convenience, a tray can be placed on a table outside the room, on which may be kept a little milk in a well-covered jug, soda-water, barley-water, etc., all covered, and all freshly-renewed morning and evening. The only thing allowed on the patient's table is a glass of water, and this the patient likes to have, especially if he suffers from thirst.

When the diet is increased and some solid food included, the invalid may still be too weak to feed himself, so that the nurse must continue to feed him patiently, and with fastidious care. In convalescence, when he is able to feed himself, the food should be brought to him daintily arranged on a tray. Small helpings, nicely served, with linen, cruet and silver spotlessly clean, will make all the difference to his enjoyment, or otherwise, of the food.

While the patient is restricted to a limited diet, the nurse must refrain from talking about food and appetising dishes which are being enjoyed by the rest of the household. If he is dissatisfied with his diet, as sick persons so often are, such conversation will not tend to make him less so.

MEDICINES AND THEIR ADMINISTRATION

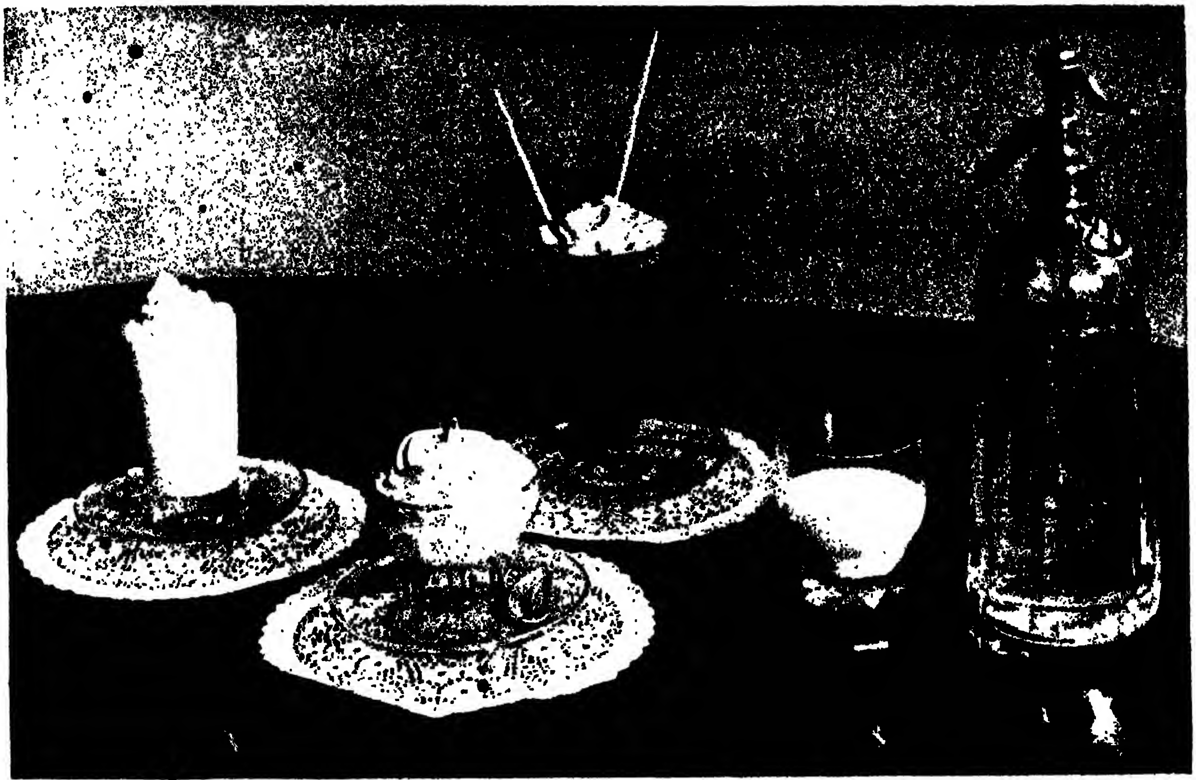
Medicines are given for many reasons: to increase appetite, to aid digestion, to ease pain, to induce sleep, as tonics, etc. Whatever object the doctor may have in mind when ordering a medicine, it is the nurse's work to follow accurately and conscientiously all instructions.

Medicine ordered to be taken *before* meals is frequently given to create an appetite, and should be given from twenty to thirty minutes before food, so that there is time for its work to be done, and not immediately before and almost simultaneously with the food. Medicine to be taken *after* food should be given ten to fifteen minutes after the meal. When medicine is ordered for administration three times a day, it is best to give it at fixed times, such as 10 a.m., 2 p.m., and 6 p.m. Special medicines, such as heart stimulants and sleeping draughts are usually ordered "as required," or "when necessary." The nurse must ask the doctor to give definite instructions as to what symptoms in the patient she is to look for which will warrant the administration of such medicines. If the patient is liable to heart attacks, the nurse must train herself to observe the signs that precede the onset of such an attack, as faintness, pallor, shallow and rapid breathing, feeble pulse, and other indications which the doctor will advise her to watch for. If a patient is

suffering from lack of sleep a special medicine may be ordered to be given "if necessary." It is *not* necessary to wake a patient in order to give him a sleeping draught. Moreover, when special medicines are ordered, it is a mark of *good nursing* to see that the environment is such that will help to bring about the desired result. For instance, when a sleeping draught is ordered, the patient should be put into the most comfortable position for sleep; his pillows should be shaken and turned the cool side uppermost, the draw-sheet pulled through so that he is lying on a cool, smooth surface, a hot bottle put to his feet. There should be the right amount of bed-clothing, the room should be well ventilated, the blinds drawn to exclude any glaring light, so that an atmosphere of quiet, drowsy peacefulness is attained, which will help to induce sleep, and reinforce the action of the medicine. If this does not have the desired effect within a reasonable time, it will be found helpful if the nurse will read aloud in a quiet monotonous voice, until the patient does eventually fall asleep. It is extremely bad nursing to administer a sleeping draught, and not to make an attempt to get the right conditions for sleep.

When administering medicines it is essential to have properly graduated medicine measures: a two-ounce medicine glass for anything from half to two ounces, and a minim, or drop measure, for doses ordered in drops. It is unsatisfactory to drop a medicine from a bottle without using a measure, because of the difficulty of getting the exact number of drops required. If, however, it is found impossible to get these measures, and a tablespoon or teaspoon has to be substituted, one spoon must be put aside for the medicine, and that spoon always used, as, owing to the various sizes of spoons, the dosage will otherwise be different each time.

A BLANKET BATH
The patient is placed between blankets and the face, limbs, chest, and back are sponged separately, avoiding exposure as much as possible.



Courtesy] ["Good Housekeeping"

ATTRACTIVE WAYS OF SERVING MILK

A milk diet need not become monotonous: different ways of serving it include junket, jellies, hot and cold drinks, and milk and soda.

FLUID MEASURE

1 minim (♏i)	-	1 drop.
60 minims	-	1 drachm (ʒi) or 1 teaspoonful.
4 drachms	-	½ ounce (℥i) or 1 tablespoonful
1 ounce (℥i)	-	2 tablespoonfuls.
20 ounces	-	1 pint (Oi).

All medicines to be taken internally should be kept quite separate from those which are for outward application only, such as liniments, ointments, etc. A nurse may think she is quite capable of distinguishing between the two, and feel certain that she will never make a mistake. Yet in times of emergency, when a patient is taken unexpectedly worse, and the immediate administration of a medicine is necessary, the most reliable and level-headed person may make an error. Obviously, the gravest consequences may result, and have frequently done so. In addition, all medicine marked "*Poison*" must be kept in a separate cupboard under lock and key.

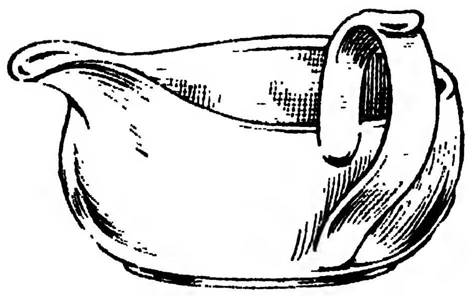
When a patient is seriously ill, the doctor must always be consulted as to the kind of aperient to be given if necessary. The nurse should realise that though a free action of the bowels may be essential, an aperient that is too severe may do very great harm to any one in a weak condition. If an aperient which has been prescribed has not produced a satisfactory result, the doctor should be informed. The nurse must observe whether the medicine has been too strong, or not strong enough, if the patient has had pain all griping medicines must be avoided as far as possible or if there has been any nausea.

Aperients.

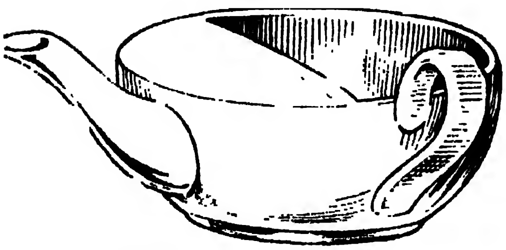
The doctor may order an enema—an injection into the bowel—in preference to a medicine by the mouth.

Medicinal Enemata.

1. Soap Enema, given to induce a simple action of the bowels. To prepare—Mix 1 oz. Castile soap in 2½ pints warm water, stir until the soap is dissolved, and give at a temperature of 98° Fahrenheit. Two pints or less should be injected, but some fluid must be left in



TREVE'S FEEDER



TEAPOT TYPE FEEDER

TWO TYPES OF FEEDER

A "Sir Frederick Treves" feeder is the more suitable as the teapot type is difficult to keep clean.

the basin, otherwise air may get into the bowel. Coloured or scented soaps should never be used for enemata.

2. Olive Oil Enema, given in cases of severe constipation to soften the hard fæces. Six to eight ounces of oil are usually given. First warm this by putting it into a small jug and standing the jug in a basin of hot water. Inject into the rectum by a glass funnel and catheter. Half to one hour after, a *soap enema* should be given.

3. Turpentine Enema, usually ordered when the patient is suffering from a great deal of flatulence that cannot be relieved. This enema requires very careful preparation. The usual method of adding 1 oz. turpentine to a soap enema is quite ineffectual, and can do harm, as the turpentine will not mix with the soap and water but floats on the top. To prepare—Bring to the boil one pint of soap and water; put 1 oz. turpentine mixed with 1 oz. olive oil into a bowl, and pour the pint of boiling soap and water slowly on to it, stirring slowly all the time. If this is carefully done, the turpentine will mix with the solution. Add a cold pint of soap and water to the enema, and administer at a temperature of 98° Fahrenheit. Wash carefully round the rectum after the injection.

4. Starch Enema, given to check diarrhœa. To prepare—Mix a teaspoonful of starch with 2 oz. cold water. Warm, by standing the jug containing it in a basin of hot water. Administer with funnel and catheter. This enema is to be retained, so administer it slowly.

5. Glycerine Enema, used for children. To prepare—Put one or two teaspoonfuls of glycerine in a glass or measure, and warm in the manner described above. Inject into rectum with a small glass or vulcanite syringe.

6. Saline Enema, given when patient is collapsed, or to prevent collapse in serious illness. To prepare—Dissolve 1 teaspoonful of salt in 1 pint of hot water. The addition of $\frac{1}{2}$ oz. glucose or 1 oz. of brandy is sometimes ordered. Administer at a temperature of 98° Fah. with a glass funnel and catheter. This is to be retained, and must therefore be administered very slowly; the bed-pan must not be given.

An enema is given either by a Higginson's syringe or by a glass funnel to which is attached a yard of rubber tubing, which has a rubber catheter at the other end.

Administration.

A tray, on which is placed a bowl containing the fluid and syringe, a small pot of vaseline, and a towel should be brought to the right-hand side of the patient's bed, and placed at the nurse's right hand. A hot bottle is always placed at the patient's feet, for in the case of serious illness there is a risk of faintness following an injection. The patient is gently turned on to his left side with his knees drawn up, and the buttocks brought to the edge of the bed, while a piece of mackintosh covered with a towel is placed under them. The bed-clothes are removed with the exception of one or two blankets. Care must be exercised to avoid any unnecessary exposure of the patient. The bed-pan (the "Perfection" bed-pan is the most satisfactory one) is heated by rinsing in hot water, and placed near at hand. When the

patient is thus prepared, the bowl containing the solution to be injected is placed near the back, the syringe filled, the nozzle smeared with vaseline and *gently* inserted into the rectum slightly backwards and upwards. Force must not be used. The fluid should be injected very slowly, and it should take at least five minutes to inject a pint, while the other end of the syringe is kept in the fluid all the time, so as to prevent air being drawn into the bowel, which would cause a great deal of unnecessary pain. When the required amount has been given, the nozzle is withdrawn, the patient turned gently on to his back, and the bed-pan placed in position.

If a glass funnel and catheter are used, the funnel should be filled with the fluid from a jug, the catheter pinched to prevent the fluid escaping, and the end lubricated with vaseline (taking care not to block the eye), and gently inserted into the rectum up to the length of three inches. The funnel should be held on a level with the patient's buttocks, so as to ensure a slow injection (the higher it is held, the quicker will be the flow), and the lotion poured in continuously so that the funnel never gets empty, otherwise air will get into the rectum. It is to prevent air entering the bowel that the funnel is filled before inserting the catheter.

If the patient is unable to turn on his side his right leg must be drawn up, the nurse's hand placed under it, and the nozzle inserted into the rectum, the basin containing the fluid being placed on the bed between the thighs. When administering an enema in this position, a towel should be placed across the patient, so that he is not exposed more than necessary.

After the bowels have acted, the bed-pan should be removed, covered with a lid or towel, and immediately taken from the room. The patient's buttocks must be washed with soap and water, gently dried, and methylated spirit and powder applied. He should then be put into a comfortable position, his bed re-made, a warm stimulating drink given, after which he is left to rest.

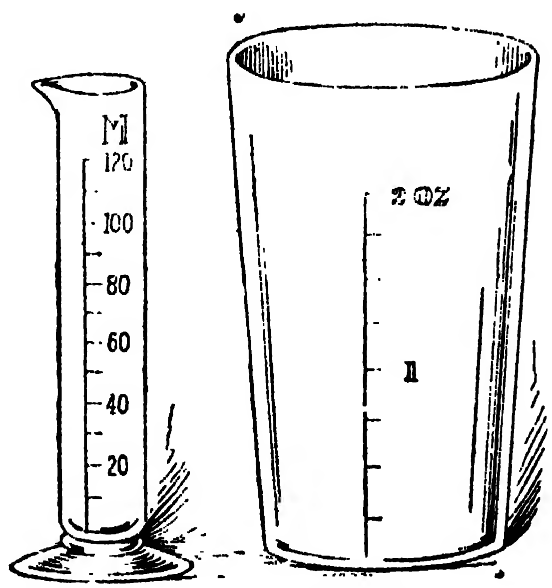
A nurse must always bear in mind that enemata of any kind are exhausting to a sick person, and therefore must be given as slowly as possible, with avoidance of all hurry and bustle, and in addition, she must be prepared for emergencies.

LOCAL APPLICATIONS

Many abnormal conditions of the body, such as inflammation, etc., call for treatment either by hot or cold applications.

1. Cold Compress.—Wring two thicknesses of white lint, or four thicknesses of white linen, out of cold water, place over the painful part and bandage in position. Renew the compress frequently, so as to ensure a *continuous cold* application.

2. Ice-bag.—Ice should be broken with a pointed instrument—hat-pin or steel skewer—and a rubber ice-bag half filled with it. In an emergency, when a rubber ice-bag cannot be obtained, a rubber sponge bag can be used. It should be half filled with pieces of ice and tied with a piece of string at the *top* of the bag, not half-way down and close to the ice. In either case, air must be expelled from the bag before it is closed, as the ice will then last longer. Cover the inflamed part with a piece of lint,



THE MEDICINE MEASURES

A minim or drop measure for doses ordered in drops, and a two-ounce glass for larger quantities.

FEEDING A VERY SICK PATIENT
The nurse should gently raise his head and shoulders and allow him to drink slowly from the feeder. The "teapot" type here shown should only be used in emergencies.

and place the bag upon it. Renew frequently.

3. Evaporating Lotion.—Soak two thicknesses of white lint in a lotion made up of one part of methylated spirit and two parts of cold water, and place it over the inflamed part. A second piece of lint should be soaking in the lotion, and be applied to the part as soon as the first begins to dry. The compress must be kept moist all the time. This treatment is used for sprains, etc.

Hot Applications.

Dry Heat can be applied by rubber hot-water bottles which must be encased in flannel bags, or there will be a risk of burning the patient; by flannel bags filled with hot salt, bran or hops; or by applying several thicknesses of hot flannels heated in front of the fire. This last method is the least effectual one.

For Moist Heat, one of the following may be ordered:—

1. Boracic Fomentations.—Materials required—A piece of boracic lint of two or three thicknesses; a piece of jaconet, slightly larger than the folded lint; a piece of white absorbent wool slightly larger than the jaconet, a bandage, and a towel in which to "wring" the lint. As tight wringing is essential, a strong towel should be used, and three-quarters of a yard of strong linen roller towelling is the best thing to use.

To make the fomentation.—Place the folded lint in the middle of the towel, roll it up and place in enamel bowl or basin with the ends lying over the edge. Pour boiling water into the basin over the middle of the towel, until the part containing the lint is completely covered. Pick up the dry ends of the towel and wring tightly. Quickly unfold the towel, apply the hot lint to the affected part, cover with the jaconet, then with the wool, and bandage securely. A fomentation must be applied hot, or it will be useless, therefore the bowl containing it should be taken to the patient's bedside, and the old fomentation removed before the fresh one is wrung out. On the other hand, care must be exercised to avoid scalding the patient, so that the towel must be wrung out very tight, for the drier it is the less the risk of a scald.

When a fomentation is being applied to a wound, *i.e.* where the skin is broken, the dressing must be done with "surgical cleanliness." To do this, the nurse must thoroughly cleanse her hands, before preparing the dressings, by scrubbing the hands in hot water for two minutes, using a clean nail-brush and antiseptic soap. She then prepares the fomentation, also a bowl of lotion (1 teaspoonful of Lysol to 1 pint of water) into which she puts small swabs of white cotton-wool; another bowl of lotion

for her hands of the same strength as the first, and an enamel tray or plate on which to place the soiled dressing removed from the wound. Having prepared these things with scrupulously clean hands, and placed them in readiness by the bed, she should remove the bandage, and then place her hands for a full minute in Lysol solution. *After this, she must not touch anything but the dressing on the patient,* which she proceeds to remove and puts on the enamel plate. She then squeezes some of the cotton-wool swabs out of the lotion, and cleanses the wound by gently wiping from the centre to the edge —never from the edges to the centre—using a fresh swab each time. She should then quickly wring out the fomentation and apply it, and bandage it in position. All soiled dressings from a wound should be burned at once, and the nurse's hands again scrubbed and disinfected by soaking in the lotion. The foment should be renewed at least every four hours, and the same precautions with regard to surgical cleanliness must be observed each time.

2. Stupes are ordered for the relief of pain when there is no wound and no danger of the skin breaking. To prepare—Place three or four thicknesses of flannel in a towel, put into a basin, and pour boiling water over; wring out towel very tightly, place flannel over painful part, cover quickly with jaconet and wool, and bandage in position. Renew at least every four hours.

3. Turpentine Stupe. To prepare—Sprinkle a teaspoonful of turpentine *evenly all over* a hot fomentation directly it is wrung out. Take care to sprinkle the turpentine evenly so as to avoid a burn. If the skin has been reddened by a turpentine stupe, spread some boracic ointment on a piece of clean white linen, and apply to affected part. Do not expose it to the air or it will become painful.

4. Linseed Poultice. Materials required —Crushed linseed—which must have been kept in a tin, otherwise it will lose some of its oil and deteriorate; a kettle of boiling water; a bowl and two plates, which must be put into hot water; a spatula or broad knife (also in hot water); a piece of clean white rag or lint cut an inch larger all round than the area to be covered; a piece of jaconet and cotton-wool the same size, and bandages. Prepare the patient first by removing the bandage and the cold poultice, and cover the area with a blanket to prevent a chill.

To prepare—Take the heated basin and pour boiling water into it, shake the linseed into it, stirring the whole time with the heated spatula or knife. When the linseed is mixed smoothly and is thick enough to leave the sides of the basin quite clean,

CONVALESCENT

When the patient is able to feed himself propped up in bed, his meals should be served on a bed-tray.

empty on to the piece of linen, and spread it to the thickness of half an inch, leaving one inch of linen clear all the way round. Fold the edge of the linen over the edge of the linseed all the way round. Place the poultice between the hot plates, and take it to the patient; apply quickly, with the linseed side downwards; cover with jaconet and wool, and bandage loosely. Change it at least every four hours.

There is always a risk of a chill when poultices have been applied, therefore care must be taken when changing them; and when they are discontinued the affected part should be covered with a piece of cotton-wool, and a thin layer of this removed every day till nothing is left.

5. MUSTARD POULTICE.—For this is required one part of mustard to four parts of linseed for an adult; one part of mustard to six parts of linseed for a child.

To prepare—Mix mustard into a smooth paste with lukewarm water; mix the linseed with boiling water as described above; stir mustard evenly into it, and spread on linen. After removing the poultice, dry the skin very gently with a piece of cotton-wool, dust with powder, and cover with wool.

6. BREAD POULTICE. To prepare—Pour boiling water on to some bread-crumbs, cover over and place over a saucepan of boiling water for ten minutes. Squeeze the water out and spread the poultice with a hot spatula on to a piece of linen. Rub a little vaseline on to the affected part first, in order to prevent the poultice from sticking.

7. MUSTARD LEAF.—Dip leaf in cold water, and apply to the affected part. Cover with handkerchief or loose bandage. Remove when the skin is slightly red. Apply a little vaseline to the skin, and cover to exclude the air.

8. MUSTARD PLASTER.—To prepare—Mix the mustard flour into a paste with cold water, and spread on a piece of muslin; apply to the affected part, *muslin side downwards*, and cover with handkerchief. Remove when the skin is slightly red; do not blister the skin. Apply vaseline, and cover to exclude the air.

TREATMENT OF FEVER PATIENTS

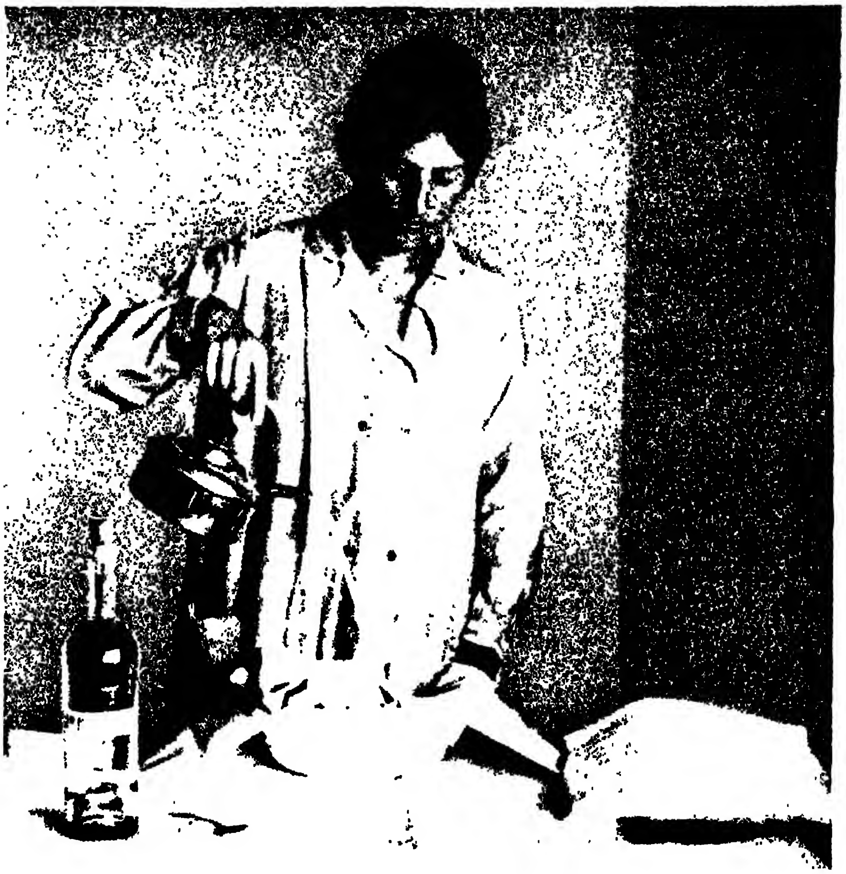
As previously stated, the normal temperature of the body is 98° Fahrenheit, and any deviation from this is abnormal. When the temperature is 100° or over, the condition is spoken of as *feverish*. In cases of *high* fever—temperature over 102°—for any length of time, the patient quickly becomes exhausted, and means are employed to effect the reduction of the temperature. There are various ways of doing this: a hot pack, which induces perspiration, is one way, and a cold pack to produce evaporation, is another.

1. HOT PACK.—Put a mackintosh sheet, covered with a blanket, on the bed under the patient. Remove the patient's clothing, and cover him with a blanket. Wring a sheet out of *very hot* water and roll it round the patient. Surround him with hot bottles, and cover him with blankets. Leave him like this for half an hour. A hot stimulating drink will help. When copious perspiration has set in, the wet sheet should be removed, the patient dried with a warm towel, the blankets removed, and a warm flannel gown put on. A hot bottle should be put to his feet, and he should be left to sleep.

2. COLD PACK.—Prepare as for the hot pack, and wrap a sheet wrung out of *cold* water round the patient. Cover him by placing a "cradle" over him, on which is spread a thin blanket. (A cradle can be simply made by placing two cardboard hat boxes, from which the two opposite sides have been removed, across the patient, like two bridges, with an interval between them.) When the wet sheet begins to get warm, it should be removed, and the second one which has been soaking in cold water wrung out and rolled round him. The patient undergoing a cold pack should be watched very closely. Twenty minutes is quite long enough to keep him in wet sheets (directions as to length of time should be obtained from the doctor), but at any time, if he complains of cold, or shivers, or changes colour, the pack must be stopped at once. The temperature should be taken frequently in the mouth, and if there is any considerable falling, the

pack should be stopped. When it is finished, remove the wet sheet and blanket, rub the patient with a warm towel, put on him a warm gown and blanket, and give him a hot bottle.

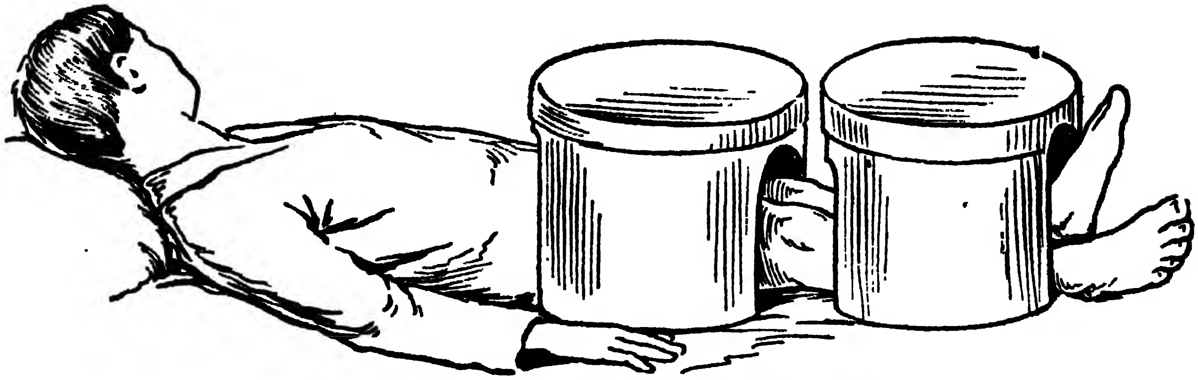
3. SPONGING is frequently ordered for the reducing of a high temperature, and often has a soothing and sedative effect on a restless patient. Put a mackintosh sheet covered with a blanket under the patient; remove gown and cover him with a blanket; place a hot bottle at his feet. Take a bowl of water at the temperature required, and put two sponges, or face flannels, into it. Lift one arm from under the blanket, place on the bath towel, take a sponge and gently sponge the arm with slow, upward movements, towards the heart. Sponge for one minute, then remove the towel, and place the arm under the blanket *without* drying it. Treat the other arm in the same way, using the second sponge; frequent changing of the sponges keeps them at a more even temperature, especially in the case of a "cold" sponge. When both arms are done, the chest should be sponged as far as the waist. The blanket should then be folded back over the chest and a second one put on over the legs, and the body sponged from the waist to the knees. The patient is then entirely covered with the blanket, and each leg done separately as in the case of the arms. Then he is turned on to his side, and the back sponged right down. Do not dry the skin; it needs the moisture, and will quickly dry of itself. Fifteen to twenty minutes is long enough to take over the sponging, and while the time is spread as evenly as possible over doing the whole body, more sponging should be given to the armpits, to the fold of the groin, and to the back of the neck, for, by so doing, the temperature is more likely to be reduced. All movements should be gentle, so as not to tire the patient more than can be helped, and all unnecessary movements avoided. A patient that is unduly exhausted after a sponging has received harm and not benefit.



PREPARING A TURPENTINE STUPE
Boiling water is poured over three or four thicknesses of flannel placed in a towel over a basin; a teaspoonful of turpentine is sprinkled evenly over the flannel which is then wrung out in the towel.

When the sponging is finished, remove the mackintosh and the damp blankets, put on a warm gown and blanket, and give a hot bottle.

The temperature of water for sponging should be :—



AN IMPROVISED "CRADLE" FOR A COLD PACK

Two cardboard hat boxes, suitably cut, can be used as a "cradle" to support the dry blanket covering the patient while a cold pack is administered.

Hot sponge—Water at 105° Fahrenheit.
Tepid sponge—Water at 85° Fahrenheit.
Cold sponge—Water drawn from the tap and not artificially cooled or heated.

When any of the above treatments is carried out, the temperature must be carefully watched. The treatment is for the purpose of reducing it, and a fall of two degrees is satisfactory. Treatment should not be continued beyond this, as a greater fall may lead to collapse. When a reduction of four or five degrees in the temperature occurs, the doctor must be informed at once.

Steam Tents.

A steam-tent is often ordered for patients suffering from bronchitis. An emergency steam-tent can be made by putting a three or four-fold clothes-horse round the head of the bed or cot, and pinning a sheet securely round the sides of the frame, with a second sheet stretched tightly over the top, so that the upper part of the bed is completely sheltered under the tent.

The steam-kettle should be filled with boiling water, the lamp filled with methylated spirit and the wick lighted, and *placed on a tin tray to prevent the risk of fire.* The tray should be placed at the side of the bed, the spout of the kettle going under the tent. Take care that the steam does not go straight on to the patient. The kettle must be replenished at frequent intervals with boiling water, so that the flow of steam is not stopped. The steam can be made more effectual by the addition of medicaments. One teaspoonful of Friar's balsam (compound tincture of benzoin) added to every pint of boiling water is very soothing, while one teaspoonful of eucalyptus oil to every pint is a fairly good disinfectant.

An INHALER is often ordered for chest and throat cases. It is filled with boiling water and whatever drug the doctor may order. If Friar's balsam or eucalyptus oil is ordered, it should be used as directed above.

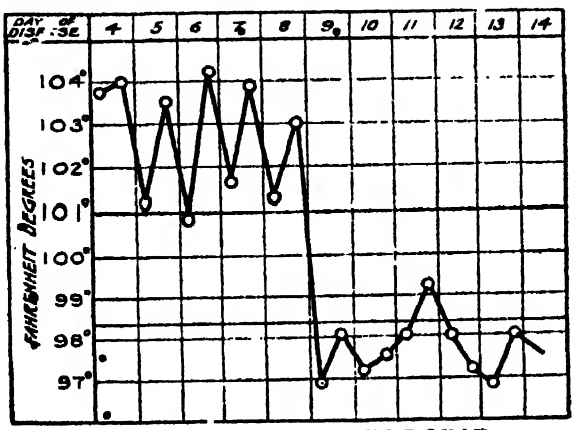
THE NURSING OF SPECIAL CASES

There are certain diseases which must be specially mentioned in regard to the nursing, because good nursing is essential if the patient is to make a satisfactory recovery.

PNEUMONIA is an acute inflammation of the lungs, and is often spoken of as "lobar pneumonia" to distinguish it from "broncho-pneumonia." The onset is acute, the temperature rising quickly to 101° or 102°. The patient must be put to bed immediately, and the doctor summoned. In a few hours' time the temperature may reach 103° or 104°. There is severe pain in the chest, with short, rapid respirations, the pulse-rate increases, and the skin becomes hot and dry. Whilst the breathing is always difficult, the patient usually gets most ease when nursed in an upright position. At the same time it must always be remembered that in pneumonia there is danger of sudden heart failure, especially when the illness reaches the crisis, and the heart must be spared as much as possible, *i.e.* it gets more rest when the

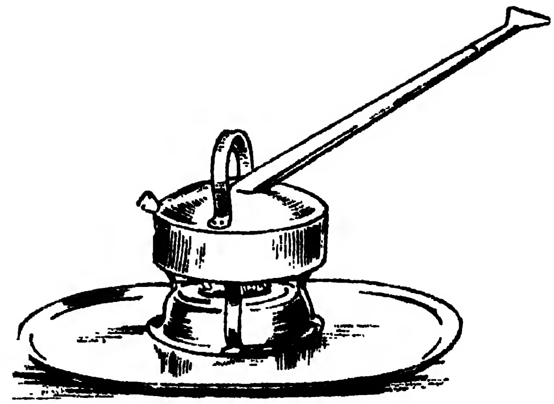
patient is in a recumbent position. The doctor must always be consulted as to the best position, whether it should be upright, supported by pillows or a bed-rest, or semi-recumbent.

Because there is this risk of heart-failure, the patient must be saved all exertion from the beginning of the illness, and kept as quiet as possible. This is often extremely difficult to accomplish, as one of the most distressing symptoms of the illness is the extreme restlessness. The nurse must realise this *from the beginning*, and do everything she can to allay the restlessness and the subsequent exhaustion. The sick-room must be kept extremely well ventilated--fresh air is especially necessary for the patient with pneumonia--and the temperature kept at 60° both day and night. The patient's gown must be light and warm, and open down the back, so that it can be put on and off with the minimum of movement. The bed-clothes, also, must be light and warm, and there should be a hot bottle at the feet. The room must be kept very quiet, and all visitors rigidly excluded. The illness is acute and short, the crisis usually occurring from the seventh to the eleventh day. At the crisis, the temperature drops suddenly from about 104° to below 98°, both respiration rate and pulse-rate become slower, and there is excessive perspiration. This is the most anxious time. Hot blankets and hot bottles



THE TEMPERATURE IN LOBAR PNEUMONIA

A typical chart of this disease showing how the high temperature drops suddenly about the eighth day to below normal.



A STEAM KETTLE

The spirit lamp keeps the water in the kettle at boiling point, and the tin tray prevents risk of fire.

must be applied, and the patient kept absolutely quiet. It is for this difficult period that the patient's strength must be conserved during the illness. A patient who has been very restless all through, who has tossed about and been unable to sleep, will be much more likely to succumb at this time than one who has been saved undue restlessness and exhaustion, and has obtained some sleep.

A pneumonia patient must not be over-fed. The doctor will probably order fluid diet. While a certain amount of milk must be given, it must not be excessive, or the stomach will become dilated and impede the already laboured breathing. Beef tea, bovril, freshly-made tea and coffee are stimulating and refreshing drinks, and require very little digestion. Let the patient have as much cold water as he can take.

From the beginning to the end of the illness the nurse must watch for signs of collapse: blueness of skin, cold sweats, increased rate and feebleness of pulse. If any of these signs appear the doctor must be summoned at once; but the nurse should also have instructions as to the treatment she can administer while she is waiting for him.

ACUTE RHEUMATISM is an extremely painful disease, and one which may last several weeks. The patient is nursed in a recumbent position, between blankets, in a flannel gown opening down the back. The sick-room must be well ventilated, and be kept at an even temperature of 65°. There is not

the same risk of heart-failure as in pneumonia, but there is a very grave danger of the heart becoming permanently diseased. Because of this danger the patient must be kept at complete rest, and everything must be done for him; he must be saved every movement. He must be fed and served in every way. Excessive perspiration with an unpleasant odour is one of the most troublesome symptoms, and necessitates the frequent changing of blankets and gown. This must be done with the greatest care and the least movement. The doctor will prescribe local applications for the inflamed joints.

"Milk only" is usually prescribed, as long as the temperature is raised. This diet must be strictly adhered to, but can be varied as previously described. Give an abundance of cold water. When the convalescent stage is reached "milk diet" is allowed; all meat and meat extracts are rigorously excluded.

To conclude this section, the nurse, whether professional or amateur, when trusted with the care of a patient acutely ill, has a position of great responsibility; to the doctor, in implicitly obeying his instructions, and in being able to give an accurate account of the patient's condition in his absence; to the patient, in creating such an atmosphere in the sick-room that he will be helped in every way possible. Patience, sympathy, help and encouragement must be given unstintingly. The restoration to health of one who has been grievously ill is a complete satisfaction to those who have nursed him.

INVALID COOKERY

By LUCY H. YATES, Author of "New Days, New Ways," "The Model Kitchen," etc.

INVALID cookery is first of all invalid catering, because preparing and planning a dietary means much more than providing nourishment at suitable intervals. Food is part of the cure, and often the most important part, and the best caterer an invalid can have is not the doctor or the nurse, with their too-often stereotyped food charts, but the most inventive, humorous, imaginative person the household can furnish—who may be of either sex!

If we could take a vote from a number of invalids upon the "points" they most appreciate in the trays served to them, it would be fairly safe to wager that an element of unexpectedness or surprise would be given the largest number. Because as digestion begins in the mouth, expectation stimulates the salivary glands, and if the senses of sight and smell are also pleasurably excited a satisfactory beginning has been already made. One who suffered much in childhood from prolonged imprisonments in a sick room has said: "When I cease to be grateful for the pretty surprises invented daily for my entertainment, for the exceeding nicety with which they were set out before me, the persuasive words that were used to tempt me when appetite failed—may my heart forget to beat and my right hand forget its cunning!" Indeed, if one were to state in the fewest words possible the essentials of invalid diet one would say—

Little daily changes,
Little daily surprises, and
Little quantities—to provoke the desire for more.

The Tray. The stereotyped invalid's tray becomes a weariness to the eyes as much on account of its lack of colour as for its lack of flavour. Both of these attributes need to be taken into consideration if we would stimulate appetite to the point of creating a desire for more. In trying to make daily changes and give little surprises most people are mainly concerned with the food, whereas the tray itself deserves attention as well. The spotless white cover may be all very well, but a charming coloured linen is better, while grass linen stitched in colours in most attractive. Polished woods are always delightful, so are coloured enamels, and the dishes should always be individual in size and shape, while if the usual glass of barley-water or milk were replaced with a well-shaped jug that held an indefinite amount there would be an

AN ATTRACTIVE TRAY FOR THE INVALID
The invalid's appetite should be stimulated by a bright and attractive tray and variety in serving.

incentive to drink more, not less! It should be remembered in catering for an invalid that good digestion does wait on appetite, and health on both.

Another small point to bear in mind, and not such a very small point either from the invalid's angle, is that hot things should be served *hot*—a cup of tea, for instance and cold things really *cold*, although seldom iced. So often one finds the tea has lost its stimulating quality because it is lukewarm, or the lemonade is unrefreshing because it is tepid.

Diet, Old and New.

While many medical men are still staunch supporters of what may be called the "old guard" in invalid dishes, such as beef tea, chicken broth, calves'-foot jelly, and the like, many more are giving to natural fresh foods a chance to prove their power of renewing vitality. Fresh fruit juice is being preferred to wine, grated vegetables and pulped fruits are preferred to either of these cooked, while steamed fish and poultry are being replaced by savoury methods of cooking that retain the natural flavours. For the help of the inventive caterer it may be useful to emphasise how iron is much more freely found in fresh green leafy vegetables and in red and black fruits when these are served uncooked, and that methods of serving them thus offer scope to the imagination. Cheese is another valuable food that may be served in very many more ways than is commonly believed, also more varieties of cheese are procurable than would be credited by those who do not take the trouble to visit little shops kept by foreign traders, or the large stores which deal with overseas goods. Fruit juices or "squashes" are now produced in variety, too, while the less familiar fruits and vegetables are worth while buying when small quantities only are required.

In the country, where really fresh milk is procurable, invalids should be treated to fruit syllabubs, to curds and whey, with buttermilk for a beverage. The point is always to seek the *fresh* article wherever possible—the fresh lemon or orange for a drink, not the ready-made lemon or orangeade, and the fresh milk or buttermilk, the

fresh green leafy vegetable or salad, and the ripe fruit.

The following suggestions and combinations may give ideas as regards contrasting colour and flavour and the association of suitable foods in dietaries that have to be Light, Slightly Substantial, and Moderately Satisfying to Highly Nourishing :—

Suggestions for Dietaries.

LIGHT.

(1) Veal and sago broth, clear, served in thin china cup. Arrowroot blancmange, with sweetened fruit juice.

(2) Chicken jelly (cold) with thin slice of lemon or orange. Egg custard with sponge rusk, baked.

(3) Barley cream soup (hot), in cup, with cheese straws. Prune jelly or orange jelly served in half-shell.

SLIGHTLY SUBSTANTIAL.

(1) Beef cup, with thin fingers of toast sprinkled grated cheese: Half-shell filled with mixed orange and grapefruit pulp, sweetened.

(2) Leek and barley broth, with cream added. Egg and cheese fondue baked in individual dish.

(3) Fillet of sole with cream sauce and grated cheese. Simple apple charlotte, made in cup, using breadcrumbs.

SATISFYING AND NOURISHING.

(1) Portion of chicken (braised) with stewed leek, or celery. Baked tapioca custard. Slice of pineapple.

(2) Mutton cutlet cooked between two plates. Baked tomato or braised onion. Boiled rice with currant jelly.

(3) Spinach with lightly-poached egg. Fingers of toast with melted cheese spread over. Orange salad in half-shell.

(4) Savoury omelet, with stewed cucumber or leek (or asparagus). Baked apple with syrup. Cheese straws with cream cheese.

(5) Fillet of fish baked in buttered paper case. Whipped potato in soufflé-case, browned on top. Fruit jelly with cream.

(6) Savoury spaghetti, baked, with cheese flavour. Grilled tomatoes, lettuce salad. Ripe fruit.

For an invalid's breakfast or supper-tray a saucerful of picked fresh fruit with cream and some dry rusks, a saucer of corn flakes with cream and stewed fruit, or grape nuts with sliced banana and cream, makes a good meal with a little thin bread and butter and a cup of milk or fresh lemonade. Or try mixing soft cream cheese with grated nuts and served with a lettuce-heart ; a ripe tomato stuffed with chopped cress and grated cheese ; or toasted bananas served with a sprinkling of sugar and lemon-juice squeezed over.

ENTERTAINING THE CONVALESCENT CHILD

By Mrs. G. H. MARSHALL (from "Hygeia," the Journal of the American Medical Association).

THE sick child in the home always brings perplexing problems, especially when the mother must be nurse as well as housewife. Since it has fallen to me lately to work out a problem of this kind, I wondered if my experiences would help some other mother who has a sick child to care for.

Elizabeth was six years old on the 23rd of March and had nearly finished the work of the first grade. So far as her parents knew, she was in fairly good health, except for a slight heart leakage, the result of a series of attacks of influenza. Without the least warning of any kind, Elizabeth awoke one morning with an acute attack of tonsilitis. A physician was called in to see her before noon, but, in spite of good care, the poison from the infected tonsils got into the blood stream and went straight to the heart. In a little more than twenty-four hours two physicians had pronounced Elizabeth's case endocarditis and had given her a bed sentence of three months. Elizabeth was an especially active child and had always been difficult to care for during an illness.

"With great care and a long rest she will get well," said one physician kindly. "For a while, I would feed her, turn her and avoid letting her reach for anything."

"Oh, doctor," I gasped, "she is so active ; it seems almost impossible to do that."

"She will co-operate," said the doctor. "She is a wise little girl and she wants to get well."

"I can try and will do my very best," I promised.

During the first few feverish days, Elizabeth was a constant care, but, much to the surprise of the doctor, her recovery was rapid. Beginning with the fourth day of her

ENTERTAINING THE CONVALESCENT CHILD
A busy mother can do many of her household tasks in the child's room, and amuse the little patient without neglecting her work.

illness, her temperature and pulse became normal and continued to be so. The doctor could not account for the rapidity of her improvement, but the bed sentence remained unchanged. Elizabeth must be quiet.

Prayerfully I asked for guidance that I might be given strength and wisdom to care for my sick child, to entertain her all day, and at the same time to look after a lively three-year-old girl and keep the house going. I had some help with the heavy cleaning and had most of my washing and ironing done, and this is the way I managed with the rest of my duties.

Early in the morning before the children awoke, I slipped quietly down into the kitchen and, while I was getting breakfast, planned the meals for the rest of the day, trying if possible to make a simple dessert for dinner. I saved much of the peeling of vegetables, mending of clothes and even the ironing to do in Elizabeth's room. I always planned, when I went to the kitchen on an errand for Elizabeth, to wipe a few dishes, to sweep a floor, or to do some little bit of work that would really count for something.

The house-cleaning season was just starting. I found I could clean Elizabeth's bedroom and some of the adjoining rooms, if I talked all the time and stepped in to see her often. I tried to make her bedroom as pretty and to give it as much of the outdoor atmosphere as possible. Every day I kept fresh flowers on the dresser and on Elizabeth's little table. On the curtain of her bedroom I pinned bright pictures of birds, flowers and animals.

When I had to leave the room for a little while I interested Elizabeth in reciting verses she had learned and in singing songs she had memorised at school. Of course, I read stories to her every day, after her crisis was passed.

I found that I must talk a great deal as I worked. While I peeled potatoes I told Elizabeth all I had ever learned about the potato; how the little eye was cut off and planted in the soil and how the tiny plant was formed with roots going down and stem reaching up. When I beat up a simple baking of tea cakes in her room, I gave her the recipe and promised that she should make them when she was able. We planned the kind and colour of frosting she liked best.

I used all the originality I had to make her trays appetising and attractive. I selected pretty dishes, pretty napkins and pretty little coloured towels. I made orange baskets; sometimes I peeled and sliced the oranges and again I quartered the orange and arranged the parts on a pretty plate. I cut her slices of toast in different shapes.

Sometimes I made, with long pieces of toast, a little log cabin, which I decorated with touches of jelly.

The first playthings I gave Elizabeth were a small gold watch that was valuable only as a keepsake and two tiny pieces of white paper. Without suggestions from anybody and with no aid from scissors, Elizabeth made an attractive set of paper furniture, with which she played for several days. She tore out tiny paper dolls and seated them comfortably on the paper seats.

Games.

Every child loves to play games, so Elizabeth and I had to play games that could be played in bed. First, I explained to my little daughter that an air castle was just an imaginary story that probably would never come true and asked her if she would like to build an air castle. She said that she would. So every day, when the restless time approached, Elizabeth and I built an air castle.

One day we screened in the south end of the front porch and furnished it with comfortable porch furniture. Another day we planned a country home by a lovely stream, where we could fish and swim. Another time, we told each other just what we would buy if we had $100. Again, we related to each other dreams we had had. All of these games helped to develop Elizabeth's imagination and her ability to tell interesting stories.

Almost every day we played imaginary hide-and-seek. We both shut our eyes, until one of us would announce that she was hidden. Then the other one would try to guess where the hiding place was. If the guesser was approaching the place, the one who was supposed to be hiding would say "warm," and if the guesser was far away from the hiding place, the one who was supposed to be hiding would tell her she was "cold."

One dark rainy day, Elizabeth and I made up happy Mother Goose rhymes. Some of them were :—

There was an old woman who lived in a shoe.
She had a lot of children
And she did know what to do.
They all helped their mother
And they minded her too ;
So 'twas a happy old woman who lived in the shoe.

Georgie, Porgie, puddin' and candy,
Kissed the girls. They thought him dandy.

Old Mother Hubbard went to the cupboard,
To find her poor dog a bone,
And when she got there
She just had to stare,
For there was an ice-cream cone.

Humpty Dumpty sat on the wall.
Humpty Dumpty never did fall ;
For he held on with all of his might ;
So that he wouldn't be dashed from sight.

Another game we played was "What is it?"

Elizabeth said, "I am thinking of an animal that is white or grey. It has pink eyes and a little pink nose. It hops instead of walks. What is it, mother?" Then, of course, I guessed a time or two, and, when I had the correct answer, it was my turn.

One afternoon Elizabeth and I took an advertisement that showed the pictures of many celebrated men upon its pages, and Elizabeth exclaimed, "Here is Dr. Carson!" "Here is Santa Claus!" "Here is Grandpa!" We had a great time play-finding all of our men friends.

On Sunday morning little sister, Elizabeth and I had Sunday school and several times we have had day school. Elizabeth always wants to be the teacher. We have played an arithmetic game several times. Elizabeth will say, "I am thinking of two numbers that added together make eighteen. What are they, mother?"

I answer, "Nine and nine." Then Elizabeth will say, "That is very good. Those are the numbers I am thinking of." It is then my turn to think of two numbers.

Elizabeth has memorised some poetry since she has been in bed and has read a very little. Her school teacher has kindly interested the children in her room to write little notes to Elizabeth and to send them through the mail. The thrill of getting a real letter or two each day has given Elizabeth much entertainment and joy.

In this way, two months of the bed sentence have been served ; and taking it altogether, it has been a happy two months for Elizabeth.

EMERGENCIES IN THE HOME*

By ETHEL BROWNING, M.D., Ch.B., Formerly House Surgeon to the Stanley Hospital and Assistant School Medical Officer, Liverpool.

In meeting any of the numerous emergencies which are likely to occur in every household, presence of mind is the first essential. Without it, even minor accidents and illnesses may be magnified into serious disasters, and real dangers prove fatal for lack of adequate attention. It is necessary to understand exactly how dangerous any emergency may be before it can be dealt with satisfactorily, and this is only possible if the mind is capable of calm consideration and unhurried decision.

The emergency may occur in a perfectly healthy person, owing to some external circumstance, or in a person who has some bodily weakness or disease. In either case a clear understanding of its nature and severity is a great help in dealing with it pending the arrival of a doctor, who should always be summoned if the injury or illness is more than a trivial one.

The common emergencies of daily life may be divided into two classes, those due to accidental, external causes, and those associated with some existing abnormal condition of the body.

ACCIDENTAL EMERGENCIES

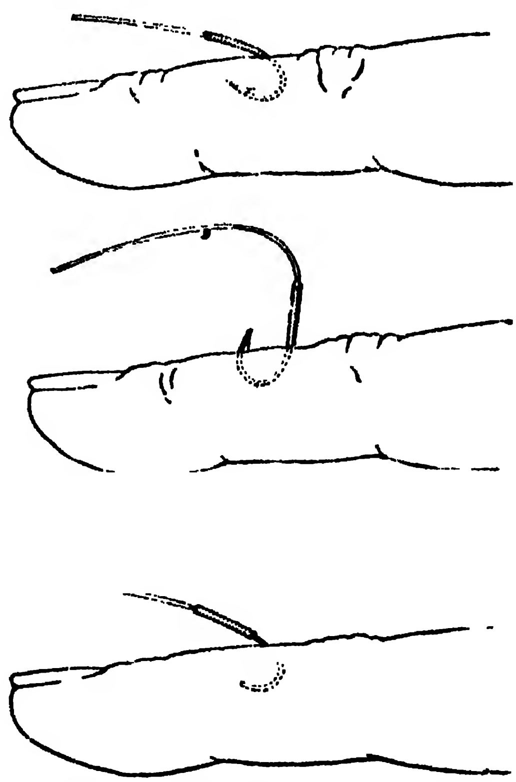
Bruises and Abrasions are the result of violent contact between the soft skin and underlying tissues, and any hard, solid object. The tiny nerves and blood vessels supplying the skin are torn and crushed, and the result is pain, diffuse bleeding and swelling. If the skin is unbroken, the best treatment is to apply lint soaked in cold water, or a mixture of equal parts of methylated spirit and water. If the skin is broken, it should be bathed with warm water, containing half a teaspoonful of tincture of iodine to the pint, and covered with a piece of lint spread with boracic ointment.

If the injury is a wound of the deeper layers of the skin, and underlying tissues, hæmorrhage may follow. (See section on "First Aid.")

A Needle in the Hand, if broken off, should never be searched for by an inexperienced person, since it is very easy to push it into the deeper tissues. The hand should be kept perfectly at rest until a doctor can attend to it. Similarly, attempts should never be made to extricate a fish hook or crochet hook by pulling it in the direction by which it entered, since the tissues will only be further lacerated.

Blisters may be caused by friction, or by heat. In either case they should be protected from further injury, and if possible left unbroken until the underlying surface has had time to heal. If they are already broken they should be covered with a protective layer of boracic powder or ointment, or, in the case of burns and scalds, eucalyptus

* See section on "The Home Medicine Cupboard."



HOW TO EXTRACT A FISH-HOOK
The hook must be pushed through the skin in another place and the barb cut off before it can be withdrawn.

FIRST AID FOR A BRUISED HEAD

If the skin is broken, the place should be bathed with warm water and iodine (½ teaspoonful to the pint).

ointment, linseed oil, or carron oil. (See section on "First Aid.")

Stings of Plants and Insects.—The pain and irritation of stings can generally be relieved by alkaline applications—dilute ammonia, or a paste of bicarbonate of soda and sal volatile. If the sting can be seen it should be extracted. In the case of mosquito bites it is well to bathe the part with an antiseptic such as weak lysol, or tincture of iodine and water, before applying the alkali.

Bites of Animals.—These should have an antiseptic such as lysol or tincture of iodine applied pending medical attention, which should always be secured as soon as possible, in view of the rather remote risk of hydrophobia or infection by septic organisms from the teeth of the animal.

Fractures.—It is sometimes difficult to distinguish a broken bone from a bad sprain, and the signs which differentiate them should only be searched for by a doctor, since attempts to move the broken fragments by an inexperienced person may result in more serious injury.

In any case where a fall or blow is followed by severe pain, swelling, loss of power, and deformity of the limb, a fracture should be suspected. The limb should be placed very gently in a position as near the normal as possible, and kept at rest until skilled treatment can be applied.

A compound fracture is one where the skin and tissues are broken and torn, so that the injured bone is in communication with the air, and therefore liable to be infected by bacteria. In very bad cases, the ends of the broken bone may protrude through the skin. Any such wound should be carefully covered with a clean dry dressing, such as gauze or lint, sprinkled lightly with boracic powder, until it can be medically attended.

It must be remembered that a bone may be broken without any outward violence to the point where the fracture occurs. Thus, the leg may be broken by falling on the feet from a height, or the arm by a violent contraction of the muscles, as in lifting or throwing a heavy weight.

Dislocations occur when the bones forming a joint are forced out of their normal position. As in the case of a fracture, there is severe pain, inability to move the affected part, and swelling. In addition the joint is obviously misshapen. The limb should be temporarily rested in a comfortable position and a pad of lint or flannel wrung out of cold water applied to it.

Sprains are injuries of the ligaments round a joint. When small blood vessels are torn there is much bruising and swelling. Rest and cold applications should be the first treatment.

Strains and Ruptured Muscles caused by strenuous over-exertion are relieved by rest and hot applications.

Under the heading "Heart and Blood

Vessels" can conveniently be described the condition known as "**SHOCK**," which always occurs to some extent in every severe accident; sometimes also through fear, or the hearing of bad news. Physical and mental prostration, with pallor, cold perspiration, and a feeble pulse, are the chief signs of this state of collapse. The heart does not beat strongly enough to supply the circulation to the body and brain. The sufferer should be well covered with rugs or blankets, the head kept lower than the feet, and hot bottles applied to the feet and abdomen. Smelling salts held to the nose are helpful, and hot drinks, containing sugar (since sugar provides heat and energy) should be given as soon as possible.

External **HÆMORRHAGE FROM WOUNDS** can usually be checked by firm bandaging, or by pressure on the artery above the wound. (See section on "First Aid.")

Hæmorrhage from the nose usually ceases if cold is applied to the nape of the neck or over the bridge of the nose.

In internal hæmorrhage due to blows on the chest and abdomen, the injured person becomes rapidly pale and cold, and the breathing becomes hurried and laboured, accompanied by deep sighing, yawning, and efforts to obtain more air. He should be placed near an open window, with all tight clothing loosened, but given no stimulants by the mouth until the hæmorrhage has been controlled.

Many external causes act upon the nervous system to produce unconsciousness. **FAINTING**, due to hot rooms or agitation, is very common, and is best treated by sprinkling the face with cold water, applying smelling salts, and putting the head between the knees. A stimulant, such as sal volatile (one teaspoonful to a cup of cold water) or hot coffee, quickens recovery.

CONCUSSION is caused by a blow on the head, or, more rarely, on the feet or buttocks. The unconsciousness may be only momentary, or may be postponed for some time. In either case, quietness is essential, and return to consciousness must be followed by prolonged rest.

HEATSTROKE OR SUNSTROKE, if not so severe as to cause unconsciousness, may produce sickness, intense headache, faintness, giddiness, a dry, burning skin, flushed face, and a quick, bounding pulse. The sufferer should be made to lie down in a cool place, and have cold water or ice applied to the head, neck, and spine.

CHOKING occurs whenever the free passage of air into the lungs is impeded. This may be produced by a tight band round the neck as in strangulation or hanging; by swallowing some object too large to pass into the stomach; by scalds, or stings of the lining membrane of the throat; or by suffocation by smoke or gas. In strangulation or

A CASUALTY IN THE NURSERY

Bandaging not only checks bleeding, but protects the cut from knocks and dirt.

hanging, the obvious first step is to cut or remove the constriction, applying salts or ammonia to the nose, and sprinkling the face with cold water.

When some object, such as a mutton bone, becomes lodged in the throat, the first step is to thump the back between the shoulder blades. If this fails, open the mouth and try to pass the fingers down the back of the throat and hook up the foreign body. If this is impossible, push it on towards the stomach.

Cases have been known where swallowing hot liquids or insects such as wasps, which have stung the back of the throat, has caused the tissues to swell to such an extent that breathing and swallowing have become impossible. Hot flannels should be placed on the front of the neck, and sips of cold water, also olive oil or salad oil, given to drink.

Choking from smoke or gas can only be dealt with by giving the sufferer as much fresh air as possible.

Foreign Bodies Swallowed.—If the object swallowed is a sharp or large one, soft, bulky foods, such as bread and milk, should be given until medical attention can be obtained. Another good remedy is a thin sandwich of cotton-wool. Castor oil should be given at once.

Foreign Bodies in the Eye, Ear, and Nose.—When irritating substances such as quick-lime enter the eye, the eye should never be rubbed. It should be bathed with warm water, a little olive or castor oil dropped in, and a pad of cotton-wool bandaged over it. If the foreign body is under the upper eyelid, lift the lid, and pull it down over the lower lid. If this does not dislodge it, place a penholder or knitting needle on the upper lid, and roll the lid back, pressing it back as far as possible until the object can be seen, when it can be removed with the aid of a twisted and moistened corner of a clean handkerchief.

The ear should never be probed for foreign bodies, or the drum may be easily perforated. If an insect has entered, fill the ear with olive oil, and it will float out.

If an object is pushed up the nostril, induce the sufferer to blow the nose with the free nostril closed, or provoke sneezing by pepper.

Poisons.

The poisons which are most likely to appear in home emergencies are various antiseptics and disinfectants; substances used for cleaning or other household and garden requirements; various medical remedies, of which an overdosage has been taken, or which have been intended only for external use; and "ptomaines" produced by contamination of articles of food.

There are several general directions to be observed in treating cases of poisoning.

(1) Give an emetic, except in the case of corrosive poisons, *i.e.* acids or alkalies which burn and stain the tissues as they come in contact with them. The safest emetic is either mustard (a tablespoonful in a tumblerful of warm water), or salt (two tablespoons in a teacupful of warm water).

(2) Give milk, raw eggs, olive or salad oil, barley water, in cases of irritant poisoning, such as arsenic. N.B.—An exception to this rule is phosphorus poisoning, which may be caused by swallowing matches. Oil dissolves phosphorus, and therefore enables it to reach the blood-stream more rapidly.

(3) In narcotic poisoning, *i.e.* that due to taking an overdose of various sleeping draughts, or cough mixtures containing laudanum, etc., give strong coffee, and keep the sufferer awake by forcing him to walk about, flicking him with wet towels, etc.

The following are some special poisons :—

(1) Antiseptics and disinfectants :—

Carbolic Acid, pure, and contained in lysol, izal, Jeyes' fluid, sanitas, etc. Give magnesia, or Epsom salts in milk.

Corrosive Subliminate.—Give white of egg mixed with water.

Iodine.—Give starch and water.

(2) Cleaning materials :—

Strong Ammonia.—Give weak vinegar and water, or lemon juice.

Salts of Lemon, and some furniture polishes (containing oxalic acid).—Give milk, oil, etc. No emetic.

(3) Substances used in house and garden :

VITRIOL (sulphuric acid), **NITRIC ACID, HYDROCHLORIC ACID.**—No emetic. Give large draughts of lime water, oil, milk, etc.

ARSENIC (in weed-killer).—Give large quantities of magnesia.

STRYCHNINE (in rat poisons).—Give permanganate of potash, followed by an emetic. Apply artificial respiration if the breathing ceases.

(4) Medicines, lotions, etc. :—

MORPHIA, CHLORAL, VERONAL, ETC., may be contained in sleeping draughts. Cough mixtures may contain **LAUDANUM,** or other preparations of morphia. Give all stimulating agents, and, if possible, an enema of strong coffee.

BELLADONNA may be contained in eye lotions. It is also the active poison in "**DEADLY NIGHTSHADE.**" Strong tea is a good antidote.

LEAD may be contained in some liniments. Give an emetic, and magnesia.

CHLORATE OF POTASH is present in some gargles and throat tablets. Give bicarbonate of soda (two teapoonfuls).

CANTHARIDES contained in some hair washes. Give an emetic and barley water. Do not give castor oil, because it dissolves the active principle.

CHRYSAROBIN AND PYROGALLOL are two poisons sometimes present in ointments given for skin complaints like eczema and psoriasis. Give a strong emetic, and as much fresh air as possible.

COCAINE.—Give strong tea, followed by an emetic.

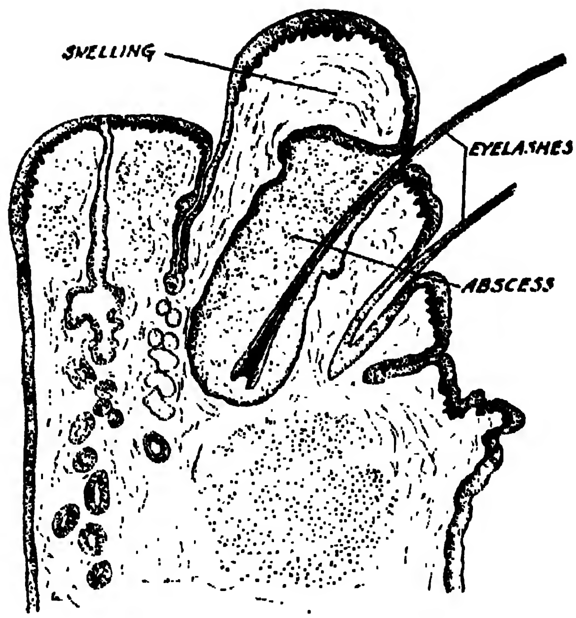
DIGITALIS, contained in medicines given for some forms of heart disease. Give strong tea, and later, strong coffee.

(5) Food poisoning may occur :—

Food Poisons

(1) By meat and sausages. The most usual form of poisoning, due to contamination with the bacillus enteritidis, produces colic, vomiting, diarrhœa, a high temperature, and collapse.

In "botulism," a rarer but more serious infection, giddiness is the first symptom, and after two days some form of paralysis appears. In the acute cases, with diarrhœa, a purgative should be given at once, pending medical treatment.



THE MEANING OF A STYE
Showing how the small abscess forms on one of the hair follicles of the eyelid.

(2) By milk, cheese, ice-cream, etc. The usual symptoms are those of irritation of the stomach and intestines. Give a purgative.

(3) By shell-fish. The gastro-intestinal symptoms are sometimes associated with a skin rash. Give castor oil, followed by Epsom salts.

(4) By fungi (toadstools, etc.). The usual symptoms of poisoning may be accompanied by faintness, delirium, and convulsions. Give an emetic, followed by a purgative, and a stimulant if there are signs of collapse.

EMERGENCIES DUE TO ILLNESS

In most cases of **HEART WEAKNESS** or disease, the chief emergencies are palpitation, and syncope or faintness. Palpitation is nearly always associated with flatulence. For this give bicarbonate of soda, or hot water containing a few drops of oil of peppermint. For faintness or signs of heart failure, lay the patient flat, with the feet higher than the head, with access to fresh air. Give smelling salts, and any stimulant prescribed by the doctor.

APOPLEXY ("STROKE"), generally occurs in stout elderly men, after a heavy meal or

strenuous exertion. The face is red and the breathing heavy, and there may be partial or complete unconsciousness. Loosen the clothing and keep as quiet as possible. If the patient is put to bed it must be done with the minimum of disturbance. Apply cold water bandages to the head.

FITS AND CONVULSIONS, EPILEPSY generally occurs in young adults. The fit sometimes begins with a cry, and the patient falls to the ground with twitching movements. The chief object should be to prevent him from hurting himself and from biting his tongue. A cushion should be placed under his head, and a rolled-up handkerchief between his teeth.

HYSTERICAL FITS are usually accompanied by emotional excitement, and may closely simulate real syncope. The face does not usually become pale, nor the pulse feeble. No treatment is necessary beyond sprinkling the face with cold water, and leaving the patient to rest quietly when the attack is over.

INFANTILE CONVULSIONS may occur during teething, at the beginning of some infectious illness, or during a disturbance of the digestive system. The child should be placed in a warm bath, and cold applied to the head. Castor oil should be given.

HIGH TEMPERATURE.—Until the cause is discovered put the patient to bed, and give no solid food.

ACUTE INDIGESTION, with pain and flatulence. Give sips of hot water containing a pinch of bicarbonate of soda, or a few drops of oil of peppermint.

COLIC.—Apply hot fomentations to the abdomen, and give hot water with a teaspoonful of brandy.

DIARRHŒA.—Keep warm, give no hot fluids to drink, but bland substances like arrowroot and milk. If it is known to be due to some article of diet, give a purgative to remove it.

INTESTINAL OBSTRUCTION.—Pain, and vomiting, of what is known as a "fæcal" nature, are the outstanding symptoms. There may be diarrhœa at first, until the part of the bowel below the obstruction is emptied, afterwards neither fæces nor flatus will pass. The condition is serious, and medical advice should be sought at once.

STRANGULATED HERNIA.—The symptoms are those of intestinal obstruction, with the addition of a swelling of the groin. If attended early enough, the hernia may be reduced without operation.

VOMITING OF BLOOD.—Give no food, but ice to suck, and apply cold compresses to the stomach.

QUINZY (ACUTE TONSILLITIS).—Gargle with hot antiseptic fluids. Apply hot fomentations to the throat.

LARYNGITIS may occur independently, or in the course of acute tonsillitis, diphtheria, etc. The breathing is noisy and difficult, the voice hoarse or whispering, and symptoms of suffocation may arise. Give inhalations of steam containing Friar's balsam (a teaspoonful to a quart of boiling water). For children a dose of ipecacuanha is a good remedy, and a steam kettle in the room is soothing.

CROUP.—The attacks of holding the breath and then breathing in with a typical crowing sound usually occur at night. The child may struggle for breath and become pale or livid, with dilated pupils. Anything which serves to stimulate the breathing should be tried—a hot sponge to the throat, immersion in a warm bath, a cold sponge to the chest, etc.

COUGHING OF BLOOD.—Keep the patient lying down, apply an icebag to the chest, and give ice to suck.

CONJUNCTIVITIS, or inflammation of the membrane covering the eyeball, should be treated by bathing with cold boracic lotion (a teaspoonful to a pint).

STYE (small abscess on one of the follicles along the edge of the eyelid). When soreness is first felt, pull out an eyelash at the point of greatest tenderness. If the stye forms in spite of this preventive measure, bathe with hot boracic lotion, and apply yellow mercury ointment.

EARACHE.—Put a few drops of warm olive oil into the ear passage, closing it with a piece of cotton wool. If severe, or accompanied by tenderness behind the ear, medical

[Photopress

A ROADSIDE EMERGENCY

The upper lid of the eye should be rolled back if a foreign body has become lodged beneath it.

attention should be secured, as the mastoid bone may be affected.

Bleeding from the Nose not due to accident can usually be stopped by cold applications to the back of the neck and the bridge of the nose. If severe, the nostril may need to be plugged with cotton wool soaked in adrenalin.

Boils, Carbuncles, Whitlows, etc. —Apply hot fomentations to the swelling until it bursts, or until a yellow "head" can be seen, which can be punctured by a needle sterilised in a methylated spirit flame. In the case of a carbuncle, ensure free drainage by inserting a wick of sterile gauze into the cavity.

THE HOME MEDICINE CUPBOARD

By FRANK WOKES, B.Sc., F.I.C., Pharmaceutical Chemist.

IN every properly equipped home there should be found an adequate supply of suitable medicines and dressings, ready to meet the immediate demands of emergencies such as are always liable to arise, and adapted for administration in cases not sufficiently serious to require prompt medical attention. It must be strongly emphasised, however, that even the simplest medicines require knowledge and common sense for their successful employment. There have been known cases of poisoning by excessive doses (several ounces) of such a common household remedy as Epsom salts! Turning to potent drugs, these should only be given in accordance with the directions of the doctor, who will, of course, be sent for as soon as any serious symptoms are observed. Nevertheless, in emergencies much good can often be done by the prompt application of proper remedies by persons who have taken the trouble to acquaint themselves

with their properties. It is the object of this section to enumerate a few of the commoner remedies which should be found in the home medicine cupboard, to describe their properties and to give brief hints on their storage and employment.

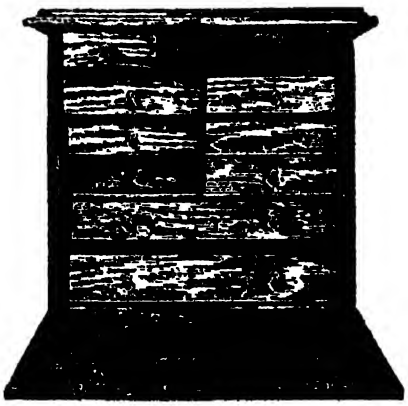
ANTISEPTICS AND DISINFECTANTS

These fall into several groups, according to the purpose for which they are to be employed. Taking first the cruder disinfectants, used for purifying sinks and drains, washing furniture and floors of sick rooms, bed-pans, soiled linen, etc., probably the most useful is LYSOL (Liquor Cresol Saponatus, B.P.,* or Liquor Cresol Glycerinatus, B.P.C.-- these are of the same strength, but the second mixes more readily with water). This can conveniently be added to water containing a little soap, at the level of about a teaspoonful to the pint. It has the advantage over CARBOLIC ACID (Acidum Carbolicum, B.P. or phenol) of being less poisonous to domestic animals but more toxic to bacteria, and over CHLORINATED LIME (Calx Chlorinata, B.P.) of possessing a less penetrating odour, and not attacking metal work (*e.g.* brass taps). Chlorinated lime is useful for cleansing the tables and floors of butchers' and fishmongers' shops, stableyards and other places where there is putrefying organic matter to be deodorised. But it must be remembered that the antiseptic action of chlorinated lime is due to the chlorine which it evolves in contact with water. There is sufficient moisture in ordinary air to ensure that after a few weeks exposure to it most of the chlorine in chlorinated lime will have been set free and lost, so that to be of satisfactory strength chlorinated lime should be bought and stored in dry, air-tight containers.

While laboratory tests on pure cultures of bacteria show chlorine to be a very powerful antiseptic, in practical treatment of decaying meat, sewage, etc., much of the chlorine is absorbed by the organic decomposition products, and the bactericidal action of the remainder passes off within a few hours. Since chlorine also attacks linen and other vegetable fibres, it must be used with caution in treating bed-linen, clothing, etc., and if a non-bleaching and purely antiseptic action is required, lysol is more suitable.

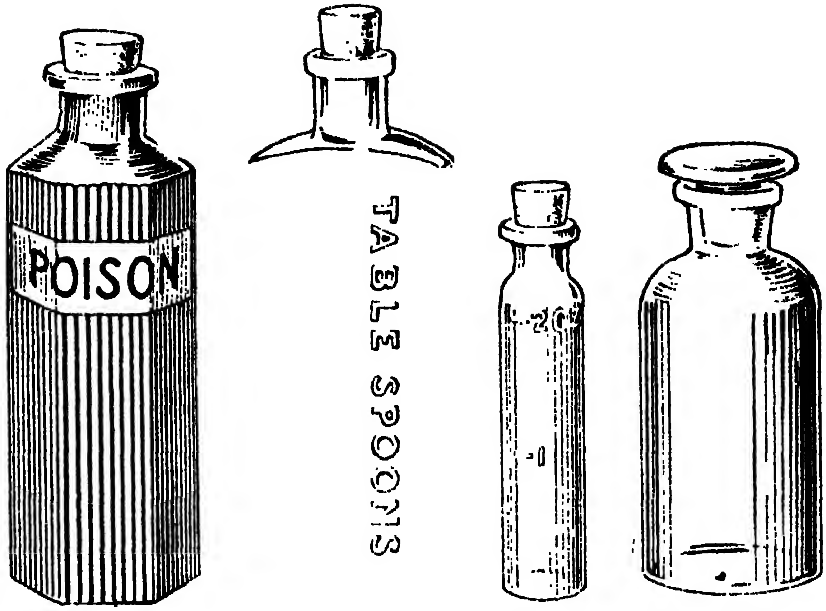
Lysol is also recommended for application to wounds. For such a purpose a brand must be selected which is not too alkaline and thus liable to damage the tissues. For discharging boils, suppurating wounds, and other infected areas, chlorine solutions such as Milton, Eusol, Dakin's solution (Liquor Sodæ Chlorinatæ cum Acido Borico, B.P.C.) may be applied, suitably diluted (say twenty to fifty times) with *cold* water on clean gauze, and renewed several times a day. If there is much inflammation, or for unbroken boils, the solutions can be added to fairly hot water in which the gauze is immediately soaked to be applied at once and covered with waterproof tissue (oiled silk or jaconet) and cottonwool. Such a hot fomentation must be renewed every hour or so. Also these chlorine solutions must be protected from the direct rays of the sun, by which they are gradually decomposed.

* Many of these articles are obtainable, in similar forms, under different names, of which the more common are given here. It must not be assumed, however, that these are all of the same composition or value. Various makes of lysol, for instance, differ widely in their germicidal activity. The preparations marked B.P., and B.P.C. are officially recognised in the British Pharmacopœia and British Pharmaceutical Codex respectively, to whose standards they must comply, and therefore should be found uniform in composition and properties.



Courtesy] [*Wellcome Historical Medical Museum*

DR. JENNER'S MEDICINE CHEST
The chest used by the famous physician who introduced inoculation.



COMMON TYPES OF MEDICINE BOTTLES

To avoid confusion keep all medicines in their appropriate bottles, especially poisons, which can be rendered conspicuous by the use of dark-coloured ribbed bottles.

Tincture of Iodine (Tinctura Iodi Mitis, B.P.), applied promptly to cuts, abrasions, insect bites, etc., may serve to prevent infection and consequent inflammation, and is most effective if the part to be treated is first dried. In the case where there is much bleeding from a wound, an excellent emergency application is a mixture of about equal parts of tincture of iodine and Friar's balsam. Care should be taken to distinguish between the ordinary tincture of iodine and the strong tincture (Tinctura Iodi Fortis, B.P., better termed liniment of iodine) which contains four times as much iodine, and is a blistering agent. Tincture of iodine is sometimes applied to the scalp to destroy parasitic fungi. If this has been done, the subsequent application of **White Precipitate Ointment** (Unguentum Hydrargyri Ammoniata, B.P.) also often used for this purpose, must be avoided, since the iodine will react with the mercury in the ointment to form mercuric iodide, a powerful blistering agent.

Since iodine rapidly attacks and destroys corks, the best method of keeping tincture of iodine is in a small poison bottle fitted with rubber cork to which is attached a camel-hail brush for painting the iodine on the affected part.

To obviate the objection that tincture of iodine produces a brown stain on the skin, a decolorised tincture of iodine (Tinctura Iodi Decolorata, B.P.C.) has been introduced in which the iodine is combined with ammonia, but this is a much weaker antiseptic.

Boric or Boracic Ointment (Unguentum Acidi Borici, B.P.) and **Eucalyptus Ointment** (Unguentum Eucalypti, B.P.) are mild antiseptics suitable for application to sores where there is little infection or inflammation and the main object is to keep air and dust out of the wound while it is healing. Eucalyptus ointment is a particularly soothing application for burns. **Zinc Ointment** (Unguentum Zinci, B.P.) is a similar ointment, but made with a softer basis, and therefore preferable as a soothing ointment for the delicate skins of children. When a very soft soothing ointment is required, zinc ointment is mixed with rather less than an equal amount of castor oil. **Sulphur Ointment** (Unguentum Sulphuris, B.P.) is often used for treatment of scabies, acne, eczema, and other skin diseases. For such purposes the addition of tar or oil of cade, as in compound sulphur ointment (Unguentum Sulphuris Compositum, B.P.C.) is considered to be an improvement. For the treatment of external piles, **Gall and Opium Ointment** (Unguentum Gallæ cum Opio, B.P.) and **Witch Hazel Ointment** (Unguentum Hamamelis) often give relief, although cure of this distressing complaint usually necessitates calling in a medical practitioner. Small tins of the above ointments can be purchased for a few pence each at the chemists, and in a fairly cool, dry place will keep for months.

Carron Oil (Linimentum Calcis cum Oleo Lini, B.P.C.), a mixture of equal parts of linseed oil and lime water, and Picric Acid Gauze (to be moistened with water just before applying) should be kept at hand for the emergency treatment of burns.

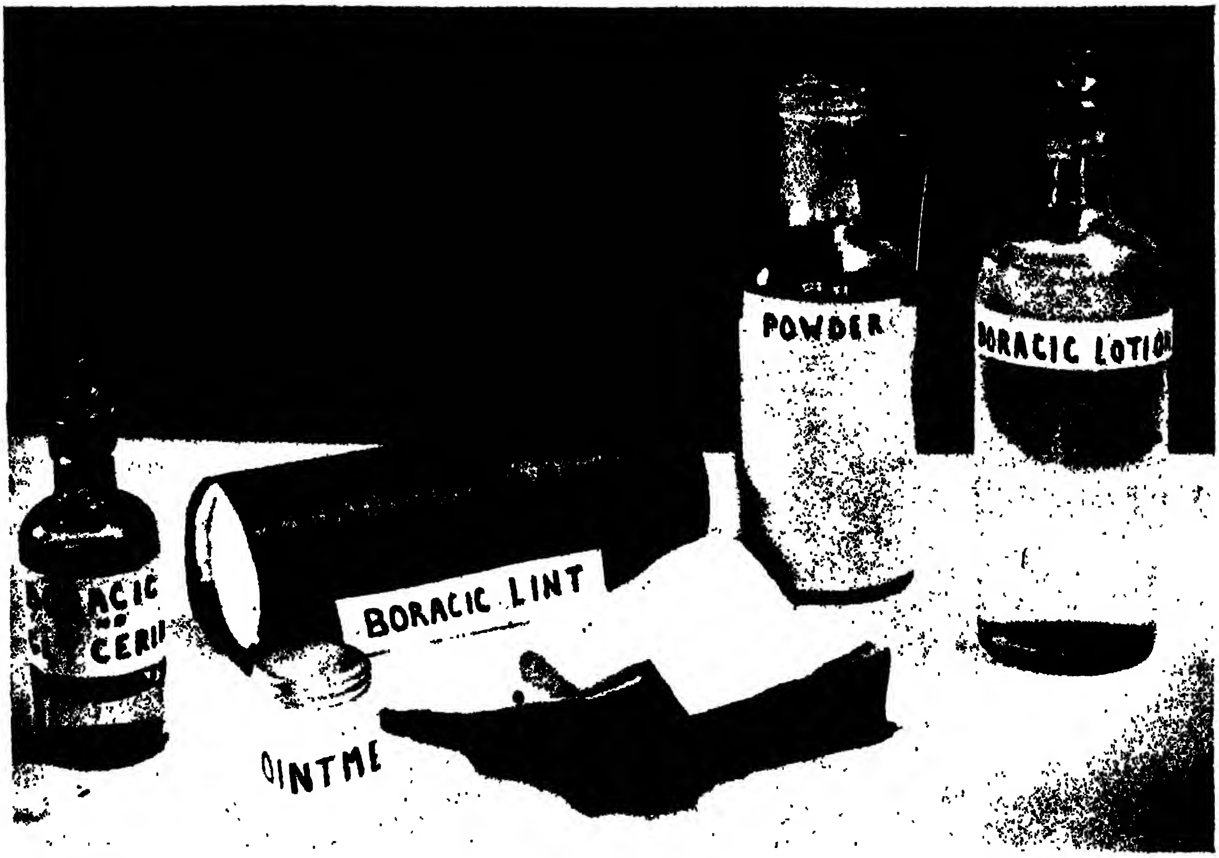
Turning next to the third group of antiseptics which comprises those designed for treatment of special parts of the body, we first consider those employed for the eye. Probably the most commonly used is Boric Lotion, made by dissolving a small teaspoonful of boric powder in a tumblerful of boiling water, straining through clean cottonwool to remove undissolved particles. This should be allowed to become cold and should preferably be freshly prepared each day, as it does not keep well. If there is much pain or inflammation, the lotion may be fortified by the addition of a few drops of Laudanum (Tincture of Opium or Tinctura Opii, B.P.), but in this case the restrictions on the sale of the latter necessitate the remedy being made up by the pharmacist. To make the lotion more astringent, there can be added a very small quantity of Sulphate of Zinc (not more than two grains to the fluid ounce), or some vegetable astringent such as Elder-flower Water (Aqua Flor. Sambuci, B.P.). Golden Eye Ointment (Unguentum Hydrargyri Oxidi Flavi, B.P.), an excellent remedy for styes on the eyelid and also for certain types of inflammation of the eye, should be kept protected from the air, and be used within a few weeks of being made,

Eye Remedies.

Courtesy] ["Good Housekeeping"

MAKING BORACIC OINTMENT AT HOME

Melt 2½ oz. of white paraffin ointment, or 2 oz. of soft paraffin and ½ oz. of paraffin wax, and stir in ½ oz. of boric acid until it solidifies. The boric acid can also be mixed with vaseline or lard.



Courtesy] ["Good Housekeeping"

FORMS IN WHICH BORIC ACID CAN BE USED

Boric acid, a mild antiseptic, can be used in the form of ointment, boracic lint, powder, and boracic lotion.

as it gradually darkens, owing to the mercuric oxide being converted to sulphide by atmospheric contamination, and may then do more harm than good. Pure almond or olive oil, applied on the tip of a camelhair brush, is very useful for removing foreign bodies from the eye. If there is much pain, a solution of cocaine may first be applied. On account of the restrictions placed on the sale of this drug by the Dangerous Drugs Act, it must be obtained from the pharmacist in the form of cocaine eye drops specially designed for the purpose. EYE SHADES are convenient to have ready for emergencies, and should be of the French fabric type with green lining, rather than the dangerous kind made of celluloid. It should hardly be necessary to add that in all treatment of the eye, the most scrupulous attention must be paid to the cleanliness of the containers, and the freshness of the remedies. It is far better economy to spend a shilling or two on new materials than run the risk of damage to the most precious of the human organs.

Ear Remedies.

Boric lotion is also employed for syringing the ears, and in case of much accumulation of wax this is sometimes first loosened by insertion of a few drops of PEROXIDE OF HYDROGEN (Liquor Hydrogenii Peroxidi, B.P.). It must not be forgotten, however, that the wax is Nature's provision for the protection of the sensitive drum, and careless and too thorough removal of it may open the way to serious damage. A much safer way is to run into the ear a few drops of warm (*not hot*) pure almond or olive oil. For severe earache an excellent remedy is a mixture of GLYCERINE OF CARBOLIC one part, with pure glycerine six or seven parts. To avoid the risk of insufficient mixing, which might involve the

introduction of a concentrated solution of carbolic into the ear, this should be obtained from the local chemist. A small bottle costing not more than two shillings will last for months or even years, since it will keep indefinitely, and only a few drops are required for each application.

Nose and Throat Remedies.

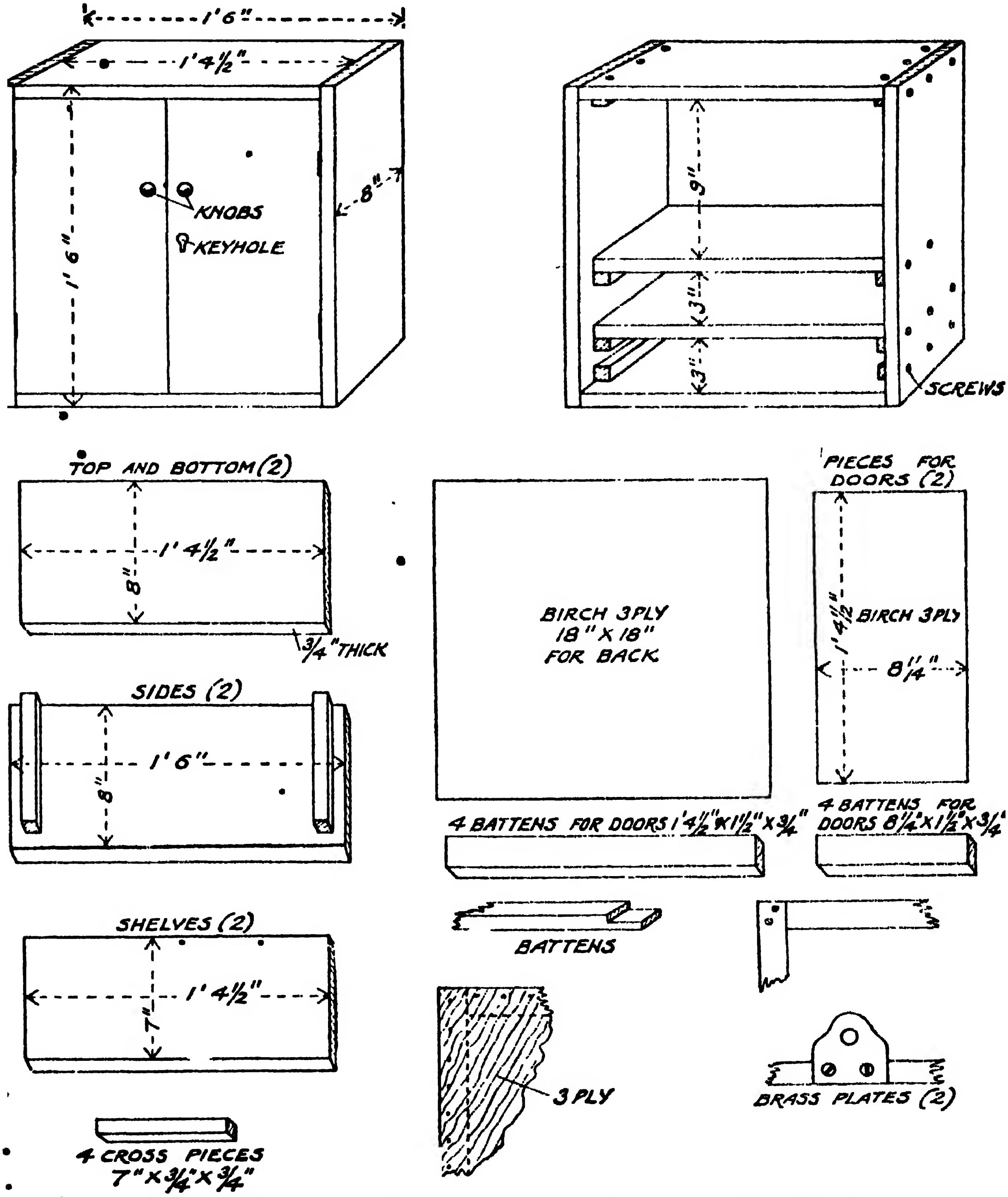
For douching the nose and throat, which may often check the onset of a cold, an inexpensive and effective remedy is COMPOUND GLYCERINE OF THYMOL (Glycerinum Thymol Compositum, B.P.C.), an antiseptic fluid which should be used diluted with five or six parts of tepid water. On account of the mildly alkaline nature of this mouthwash, it is of advantage in neutralising the acids which arise by bacterial decomposition in the mouth, and which may affect salivary digestion. CHLORATE OF POTASH is a more powerful antiseptic for the mouth and throat, and is employed either in the form of pellets to be sucked, or dissolved in hot water (about a teaspoonful in a cupful). The previously mentioned chlorine solutions also form very powerful antiseptic mouth-washes, but care should be taken in their use with artificial teeth, since the chlorine may attack and gradually dissolve the gold plate. PERMANGANATE of POTASH, about one part in two thousands of warm water (to make a *light* red-coloured solution) is very useful as a mouthwash after extraction of teeth. It is also used as an antidote in opium poisoning, and in cases of snake bite the solid crystals should be packed into a cut made at the point of the bite as soon as possible after the injury is inflicted. FRIAR'S BALSAM (Tinctura Benzoini Composita, B.P.) should always be kept at hand, as it does not deteriorate, and may be of great service both for application to bleeding wounds and as an inhalation for treatment of sore throat. In the latter case a teaspoonful should be poured on top of about a pint of *boiling* water already in a jug, the top of which should then be surrounded with a cloth, and the mouth applied so as to inhale as much as possible of the steam, which carries up the healing principles of the balsam. For cases of cold in the head, a few drops of EUCALYPTUS OIL may be added to this inhalation, and care taken to breathe out through the nose so as to carry the volatile principles through the nasal passages.

Suspected infection of the throat (*e.g.* following contact with cases of infectious diseases) is often treated with FORMALIN (Liquor Formaldehydi, B.P. or Solution of Formaldehyde) employed either as a mouthwash and gargle, or in the form of tablets. This potent remedy should be used with caution, since it acts as an irritant to mucous membranes lining the throat and nose if in too high a concentration, and also it may upset the digestion if much of it is swallowed. Its usefulness is sometimes increased by the addition of cinnamon or other essential oils. Formalin is being increasingly employed for the disinfection of rooms in which infectious cases have been present, and has the advantage over the old-fashioned sulphur candle that it does not injure metals or fabric, or attack the paint. For this purpose it is either sprayed, in a cloud, over the whole of the room and its contents, or better, vaporised by addition of one part of permanganate of potash, or two parts of chlorinated lime, to every two parts of the formalin. Tablets can also be obtained which give off formaldehyde when heated. The chimney, windows, and all other outlets should, of course, be pasted over, and the room left closed for ten hours to allow the formaldehyde gas to exert its germicidal action.

PEROXIDE OF HYDROGEN (Liquor Hydrogenii Peroxidi, B.P.) is a powerful antiseptic which liberates oxygen in contact with organic matter, and hence is very useful for cleansing wounds from morbid matter, and for temporary application to cavities in the teeth until they can be treated by the dentist. Since it usually loses most of its available oxygen within a few months, it should not be kept too long, and if put in too warm a place the oxygen may be set free so rapidly as to burst the bottle.

When it is desired to exert antiseptic action in parts of the digestive tract below the throat, or in other internal regions in the

HOW TO MAKE A SIMPLE MEDICINE CUPBOARD



DIRECTIONS : Screw the sides on to the cross pieces with 3, 1½" No. 8 iron screws, leaving ¾" at the ends to take the top and bottom planks, which will be screwed into the cross pieces in the same manner. Keep the latter flush with the back to leave space in front for the doors. The shelves are fitted either by screwing directly or (better) by supporting them at the ends by small slips of wood. Fasten the plywood on the back with ¾" oval brads at 2" intervals. To make the doors, screw the battens together as shown above with ¾" No. 6 screws, two to each joint, and nail (as with the back) the plywood pieces on the frames so formed. Hang the doors with 2, 1½" × ¾" steel butt hinges. Fit 1½" × 1" cupboard lock to one door and a small brass hook and eye to the top and bottom of the other. Furnish both with small brass knobs. Stain with matsine, or interior solignum, or paint with white enamel. Clean white deal will be cheapest and most easily worked, but any wood may be used and 3-ply to match. *Small requirements :* 3 doz. 1½" No. 8 screws; 16 ¾" No. 6 screws; 1 doz. hinge and 4 lock screws; 2 ozs. ¾" oval brads for plywood.

[*Int. Graphic Press*

HOME DISINFECTION AFTER ILLNESS—I.
All outlets such as window-frames, doors and chimney, should be pasted over before fumigation.

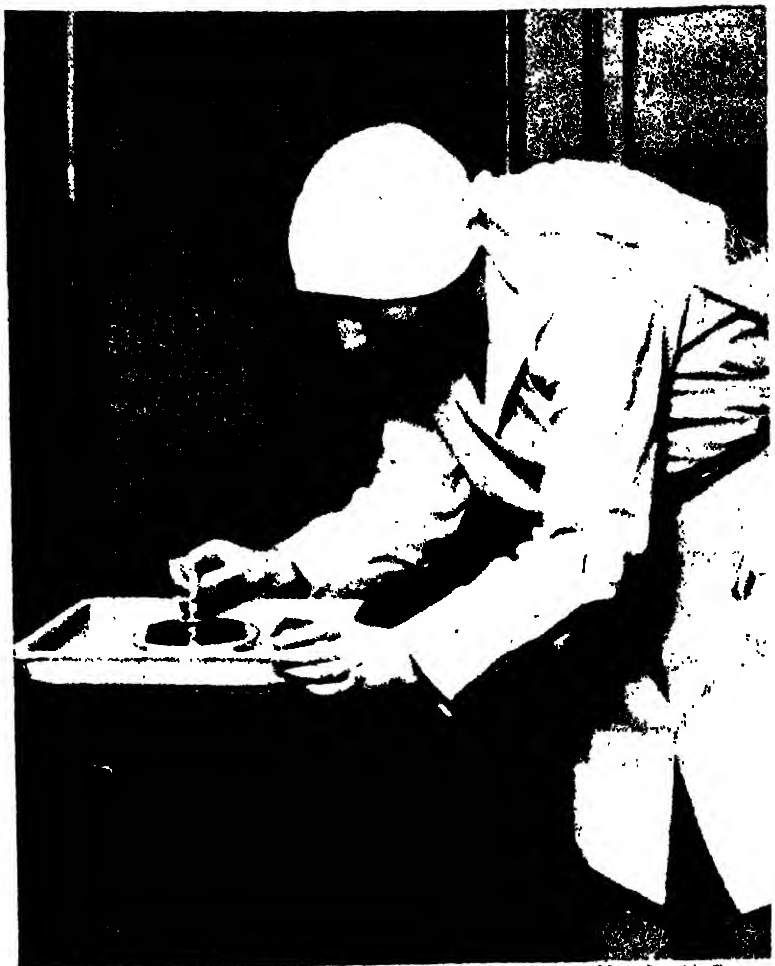
body, the problem usually demands medical direction. There are, however, certain simple remedies which the layman is justified in using with caution. First amongst these are the essential oils, such as peppermint, cloves, aniseed, dill. It must not be assumed that the pungency of these is always an indication of their strength as antiseptic. Essence of peppermint, and essence of ginger, which are familiar ingredients in mixtures intended to relieve indigestion, etc., probably exert very little antiseptic action in the concentration usually employed, though they are certainly soothing to the stomach. OIL OF CLOVES is, perhaps, the most potent of the essential oils, and is an excellent remedy for toothache. DILL WATER (Aqua Anethi, B.P.) often gives relief to babies suffering from mild digestive troubles.

Intestinal Antiseptics.

POWDERED CHARCOAL, PREPARED CHALK, or KAOLIN specially prepared and purified, may be of great benefit in certain intestinal complaints such as diarrhœa and colitis, but since these may be symptoms of serious disease, medical advice should be obtained. These special absorbent powders readily take up gases and odorous emanations, and therefore should be bought and stored in airtight containers (preferably bottles) to avoid atmospheric contamination.

CASTOR OIL is an old-established aperient which, in proper doses, may be given with safety to the youngest infant. By virtue of its oily nature, castor oil acts as a lubricant as well as an aperient, and is often effective in removing an accumulation of decomposing matter which might have served as a source of appendicitis. Repeated doses of castor oil may lead to constipation, which is an objection against its regular employment, but an advantage when it is used to treat diarrhœa due to one of the aforesaid accumulations. On account of the dislike of many children to the greasy taste of castor oil, so called "castor oil tablets" have been introduced. These, however, do not contain any castor oil, and owe their purgative action to phenolphthalein, a synthetic coal-tar derivative with entirely different properties, and, of course, no lubricant action. If a milder laxative and lubricant to the intestinal tract is required, refined MEDICINAL PARAFFIN is probably the most satisfactory. For a drastic non-greasy purge, EPSOM SALTS (Magnesii Sulphas, B.P.) can be administered, the most rapid action being obtained

if this is taken on an empty stomach, with a drink of hot water or weak tea. The dose should vary from one teaspoonful for a young child to half an ounce for an adult, or in obstinate cases as much as one ounce can be given. Large doses tend to produce a lowering effect, and it is advisable for the patient who has received them to remain in a warm place, and take only light food in order to give both his muscular and digestive system a rest for the remainder of the day. **Black Draught** (Mistura Sennæ Composita, B.P.) is a powerful purgative drink in which the action of the Epsom salts is enhanced by the addition of an infusion of senna leaves. Epsom salts, cascara, and other artificial purgatives, should not be allowed to become a habit. Under normal conditions regulation of the bowels should be ensured by the inclusion of a proper amount of suitable fruit (*e.g.* figs, prunes, apples, oranges) in the diet, with the assistance of exercise designed to employ the abdominal muscles. For infants, and in some cases for adults also, the most suitable method of obtaining a thorough evacuation of the bowels in cases of obstinate constipation is by means of an enema of hot water and soap, administered through a Higginson's syringe.



[*Int. Graphic Press*

HOME DISINFECTION AFTER ILLNESS—II.
To fumigate the room a sulphur candle is burned, or, better, one of the formalin methods may be employed.

REMEDIES FOR HEADACHE AND NEURALGIA

For treatment of headache, neuralgia, etc., probably the commonest remedy is **Aspirin** (Acidum Acetylsalicylicum, B.P.) in the form of tablets, powders or cachets. There has recently been an attempt on the part of certain manufacturers to create the impression that their particular make of aspirin is the only one which is safe to take. Such a suggestion is not supported by facts. Analyses show that the leading makes of aspirin are all equally pure, and the chemistry of acetylsalicylic acid is so well known that there is no excuse for any manufacturer of repute to supply an unsatisfactory product. The real objection to the frequent consumption of aspirin, of any make, is its lowering action, together with reduction of body temperature to below normal, when taken in large doses. Aspirin, therefore, should also be treated as an emergency medicine.

In addition to aspirin, numerous other organic chemicals are employed, such as acetanilide (antifebrin), antipyrine (phenazone), phenacetin, with or without caffeine,

various bromides, etc., which are found in many advertised headache powders and tablets. Of these phenacetin, which is often taken in conjunction with other drugs such as caffeine, aspirin or bromide, is probably the least harmful. But all these remedies are open to similar objections. When used under medical directions as emergency medicines for certain conditions, they may be of great service. Taken, as they often are, indiscriminately, with no regard for their potency, whenever a headache threatens, they may do more harm than good. It should always be remembered, in the case of some powerful drugs intended to relieve pain, that a dose not much larger than the one ordinarily taken may prove dangerous or even fatal. Cases have been known of a patient who has on many occasions taken, say, two tablets of this nature with no noticeable ill effect, but on doubling the dose to treat an unusually severe attack of pain, the four tablets have resulted in death. Each dose of such potent tablets should be checked by another individual, who should be fully acquainted with all the circumstances of the case. Great care should also be taken to keep all such tablets out of the reach of children, since they are often made dangerously attractive by sugar or chocolate coating.

Seidlitz Powders (Pulvis Sodæ Tartaratæ Effervescens, B.P.) are a safe and agreeable remedy for biliousness and sick headaches; their flavour may be improved by addition of a few drops of essence of ginger.

Effervescent Citrate of Magnesia is a mild aperient very suitable for children; its medicinal nature can be disguised by addition of half a teaspoonful of Syrup of Lemon (Syrupus Limonis, B.P.). All effervescent preparations should be kept in dry, air-tight containers, preferably well corked bottles.

TONICS AND NERVE MEDICINES

Most of the numerous tonics on the market require to be taken under proper medical advice in order to produce the best effects. The fact that a tonic is needed implies that the body has been subjected to some form of strain, which the doctor may be able to detect and remove. For this purpose some modification of the daily routine may be prescribed and prove of equal importance to the actual tonic taken.

Phosphorus in one of its numerous combinations is one of the commonest constituents of medicines designed to exert a tonic action. Diluted Phosphoric Acid (Acidum Phosphoricum Dilutum, B.P.), mixed with quinine, forms the basis of certain preparations widely advertised as a cure for all kinds of nervous diseases. Taken according to the directions, these are sometimes of benefit in cases of weakness following influenza, etc. Easton's Syrup (Syrupus Ferri Phosphatis cum Quinina et Strychnina, B.P.) is a powerful remedy containing strychnine, which should only be taken in strict compliance with medical instructions. This is often supplied in the form of sugar-coated tablets in bottles or other packages bearing little indication of their dangerous nature. Great care should be exercised to keep such tablets out of the reach of children, and to avoid mixing them with other innocuous tablets indentical in appearance. Parrish's Chemical Food (Syrupus Ferri Phosphatis Compositus, B.P.C.) should be carefully distinguished from Easton's syrup, being a perfectly safe preparation of the phosphates of iron, calcium, sodium and potassium which forms a good general tonic for women and children. Compound Syrup of Hypophosphites (Syrupus Ferri Hypophosphitis Compositus, B.P.C.) is intermediate in strength, and contains quinine and strychnine in about one quarter the proportion found in Easton's syrup, besides the hypophosphites of calcium, manganese and potassium. The results of recent researches would seem to indicate that manganese may play a more important part in the human body than was previously suspected. Since there are several syrups of hypophosphites supplied by different manufacturers under various trade names, and these differ considerably in their potency, it is advisable to confine oneself to a standardised preparation,

such as that officially recognised in the British Pharmaceutical Codex.

Phosphorus in organic combination, such as the lecithin of egg yolk, or the phosphoproteins of milk, is an essential constituent in many valuable tonic foods.

VITAMIN PREPARATIONS

For the prevention or treatment of rickets, tuberculosis and various diseases of the respiratory tract, an adequate supply of vitamins A and D is essential. These may be obtained in the diet, if a sufficient amount of greenstuff (*e.g.* water-cress, spinach), egg-yolk and milk (about a quart a day) be consumed. To avoid all danger of deficiency, or in a sudden emergency, it may be advisable to supplement the dietetic sources of those vitamins by cod-liver oil, their most potent natural source. Or vitamin D may be supplied in the form of irradiated ergosterol, which is now being sold in various combinations under different trade names. Whichever of these concentrated vitamin products is selected it should be furnished with a certificate stating that it has been tested for its vitamin potency by a recognised authority, such as the Pharmaceutical Society of Great Britain.

STIMULANTS

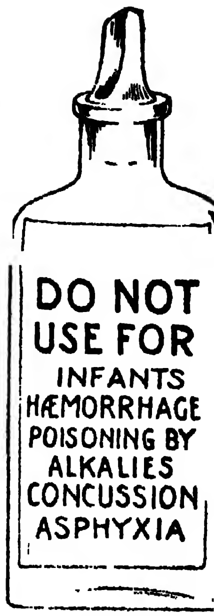
SAL VOLATILE (Spiritus Ammoniæ Aromaticus, B.P.) is probably the best general stimulant for use in emergencies, and a supply should always be kept, preferably in a glass-stoppered bottle, since the ammonia attacks a cork. This bottle should bear a label giving a list of the conditions in which a stimulant is not to be employed (see the section on "First Aid.")

A mixture of sal volatile with enough bicarbonate of soda to form a thin paste is an excellent soothing application for wasp and other insect bites.

SOLUTION OF AMMONIA (Liquor Ammoniæ, B.P.) either alone or in the form of smelling salts, will often revive a fainting person if cautiously applied to the nostrils. Preparations of ammonia should always be kept in tightly stoppered bottles.

APPLICATIONS FOR THE SKIN

With the object of repelling insects, various essential oils and preparations of them have been employed. OIL OF LAVENDER is a popular remedy, but is very expensive. Cheaper and probably more effective are citronella, clove, cassia and brown camphor oils, whilst the most effective of all appears to be crude kerosene. If these oils are supplied neat, their protective action is soon lost as the oil evaporates. They should be mixed with lanoline or vaseline, not more than two or three parts to each part of oil, when a certain measure of protection may be ensured for several hours.



A WISE PRECAUTION
Sal volatile is a good general stimulant, but, to prevent wrong use, a list of "don'ts" should be kept on the label.

Numerous preparations, of varying merit, are offered to protect the skin against summer sun, and to prevent roughness and chapping in winter. Some of these contain mild antiseptics or cooling substances such as boric acid, menthol, wintergreen, witch-hazel. Two simple and effective remedies are glycerine and cucumber cream, containing benzoin and other aromatic constituents, and camphor ice, if made with a base of glycerine, spermaceti and bees-wax. Most of the camphor ice on the market is made with a cheap basis of paraffin wax, and is of little value. Simple SPERMACETI OINTMENT (Unguentum Cetacei, B.P.) is probably more effective than these paraffin wax preparations.

Distilled extract of WITCH-HAZEL (Liquor Hamamelidis, B.P.) is a mild antiseptic, astringent lotion, with slight cooling properties owing to the small amount of alcohol it contains. Alcohol itself is often used as a cooling application to the skin, for the prevention of bed-sores, and in suitable

dilution to harden the nipples before lactation. In this connection methylated spirit was formerly largely employed as a cheap substitute for the expensive pure spirits of wine. But since the Excise Regulations now require methylated spirit to contain pyridine, which is very irritating to the skin, methylated spirit should only be used for burning, and its place as an application taken by SURGICAL SPIRITS, which is obtainable from most pharmacists.

Various lotions and embrocations are employed for the treatment of sprains and bruises. OPODELDOC or SOAP LINIMENT (Linimentum Saponis, B.P.) is a simple alcoholic solution of soap and camphor, perfumed with rosemary oil, generally suitable for rubbing in mild cases. Solid Opodeldoc or Camphorated Soap Liniment (Linimentum Saponis Camphoratum, B.P.C.) is a stronger preparation, containing a little ammonia as a stimulant, and should be kept in well-corked bottles, and used fairly fresh. CAMPHORATED OIL (Linimentum Camphoræ, B.P.) is an old-fashioned and excellent application for the chest and back of children, which should be carefully kept apart from medicines intended for internal use, as there have been a number of deaths caused by its being given in mistake for olive oil, which it resembles in appearance. It is often fortified by the addition of ammonia, as in Ammoniated Liniment of Camphor (Linimentum Camphoræ Ammoniatum, B.P.), oil of cloves, or amber, etc. TURPENTINE (Oleum Terebinthinæ Rectificatum, B.P.) is a common ingredient of embrocations and strongly stimulating liniments, such as Liniment of Turpentine (Linimentum Terebinthinæ, B.P.), or Diluted Turpentine Liniment (Linimentum Terebinthinæ Dilutum, B.P.C.), which is half the strength of the first. ACETIC ACID enters into the composition of a number of liniments (*e.g.* Liniment of Turpentine and Acetic Acid or Linimentum Terebinthinæ Aceticum, B.P., White Liniment or Linimentum Album, B.P.C.), in which both a stimulating and an irritating action is required. In case of severe pain, certain preparations containing opium may be employed under the doctor's directions. Of these there may be mentioned LINIMENT OF OPIUM (Linimentum Opii, B.P.), Ammoniated Liniment of Opium (Linimentum Opii Ammoniatum, B.P.C.) and Lead and Opium Lotion (Lotio Plumbi cum Opio, B.P.C.). The last, applied hot on lint, probably is the most effective remedy for the treatment of very painful sprains. All these must be kept in a safe place with other poisons, are best used not more than a week or two old, and should not be applied to the broken skin.

In the external treatment of lumbago, rheumatism, neuritis, and other acute nervous complaints, two classes of medicaments are employed, and are found in many widely advertised preparations. First there is the counter irritant such as CAPSICUM (which may be applied as a liniment (Linimentum Capsici, B.P.C.) or ointment (Unguentum Capsici, B.P. ; Unguentum Oleoresinæ Capsici Compositum, B.P.C.), or on cotton-wool (Gossypium Capsici, B.P.C.), or CANTHARIDES, which is used either in solution as Blistering Liquid (Liquor Epispasticus, B.P.), or as a Blistering Plaster (Emplastrum Cantharidini, B.P.). These should be applied with discretion, as the susceptibility of individuals to their action varies considerably. Secondly, there are the soothing and anodyne substances, such as methyl salicylate (oil of wintergreen), belladonna and opium, which enter into the composition of many ointments, liniments and other external applications. These should all be kept in a safe place, apart from medicines intended for internal administration. Those containing belladonna or opium should only be used under medical directions, since the need for such potent remedies implies a more or less serious condition, necessitating skilled attention. Care should be taken to avoid touching the eyes with fingers which have been in contact with these substances.

STORAGE AND USE OF MEDICINES

This section may aptly be concluded with a few simple rules to be observed in the storage and employment of medicines.

1. All medicines should be kept in a definite place, out of the reach of children, and should be correctly labelled with the name of the medicine, patient, dose, name of seller; and (in case of any preparations which deteriorate on keeping) date of purchase.

2. Poisons should be kept apart from all other medicines, preferably in a locked cupboard, and in containers where the dangerous nature of the contents is indicated by conspicuous labels, different coloured glass (blue or green) and a characteristic shape (*e.g.* ribbed) which can be recognised by touch, even in the dark.

3. When any bottle or other container is to be used for any medicine different from its original contents, it must be first thoroughly cleaned out, and all the old labels removed. Many serious mistakes have been caused by neglect to take this precaution.

[Keystone

AN IMPORTANT "DON'T" FOR MOTHERS

Do not keep the medicine cupboard within reach of children. The poisons especially should be under lock and key.

4. A card kept in the medicine cupboard bearing a list of the contents will serve as a check on any missing articles, and help to prevent those running short, leaving one unprepared to meet a sudden emergency.

5. Medicines should not be measured by means of domestic spoons, but in properly graduated glass measures, of which two should be kept, a large one for doses of two teaspoonfuls or more, and a small one for doses of one teaspoonful or less.

6. Before any medicine is given, the directions on the label should be carefully studied. If any deviation be made from these directions, either in regard to amount given, or time at which given, a written note should be made of this, and shown to the doctor at his next visit.

7. Sometimes a medicine may be modified by the doctor (e.g. by removal of an ingredient, or alteration in strength) without a fresh prescription being written. In such a case, a note regarding the alteration should be made on the label, to avoid confusion with an old bottle of the original formula.

8. All orders for medicine should be clear and unambiguous, if possible in writing, but if given verbally, the recipient of the order should be made to repeat it word by word. Any reference numbers or letters attached to a prescription should always be quoted when the prescription is being renewed.

9. In regard to patent medicines, many of which are advertised to cure all kinds

of complaints, it should be remembered that even in those cases where the manufacturer is seriously attempting to supply a satisfactory article, he is under the great handicap of having no proper control over the dosage of his product, and its correct variation according to age, condition and susceptibility of patient. Remedies which are sold for unrestricted consumption by the multitude must necessarily be simple and free from very active medicaments. For efficient treatment of disease, it is most satisfactory, and cheapest in the long run, to make use of the services of the qualified medical man and pharmacist, who from their years of experience, and responsible position in the community, can well be trusted to play their part as guardians of the public health.

THE SELECTION OF A FAMILY PHYSICIAN

By Dr. DONALD B. ARMSTRONG, Assistant Secretary to the Metropolitan Life Insurance Co., New York.

THE family physician—the personal medical adviser—has, through generations, been to many an invaluable guide, counsellor, and friend. Unfortunately in many communities and for a large majority of people, the family physician has now become almost a tradition of the past. Many factors have contributed to this situation. The increased urbanisation of the population ; the greater frequency with which people move from one community to another ; the consequent partial depersonalisation of most human relationships ; the increased specialisation in medical practice ; the development of socialised or state medicine, such as medical work in schools, industries, and insurance groups ; the invasion of medical practice by various fads and forms of quackery, and by cults such as Christian Science—all of these influences have tended to disrupt the directness and intimacy which previously characterised the relationship between the physician and his patient.

Yet, the family physician performed an invaluable service. Remarkable were the opportunities for the physician who knew all members of the family ; who was acquainted with them during both periods of health and disease ; and who, thereby, was better able to detect incipient signs of illness and to advise with reference to the general health of all members of the group. It is important for us to-day to realise that the intelligent, well-trained and professionally qualified physician can frequently serve as the most valuable friend of the family and the individual. Yet, at the present time, there are many people in every community with no recognised medical connections. There are many who have moved recently from distant communities and have made no medical contacts. There are also many who have had no occasion to call a physician for a long time in the past, but who may suddenly need one to meet an emergency, or may simply desire sound health advice or a health examination. Any of these circumstances may present a serious problem to an individual so situated.

Nearly every one desires sound medical advice. Nearly every one is desirous of avoiding chicanery and fraud. Yet, for people without established medical service contacts, there is in very few communities any reliable machinery that will give the necessary directions to authentic health and medical guidance.

However, even under these circumstances, an informed person can follow certain guides in selecting a physician—directions that will lead him to satisfactory and competent service.

It may be desirable in the first place to review the circumstances under which a person needs trustworthy medical service. Such service is naturally needed when a person is ill and desires to get well. In addition to meeting the requirements of acute, incapacitating illness, a doctor should be consulted when one has a cough that hangs on, when one has a chronic pain or

any persistent ailment, when one has a lump anywhere in the body that does not go away, when one is tired all the time.

A more modern conception of medical service is recognised by the individual who calls the doctor not only when he is ill, but also when he is supposedly well and desires competent medical guidance as to how to keep well. Certainly, every one should have, once a year, a general overhauling, preferably by the same physician. The time to go to a doctor is before one is ill. The physician can often keep a minor illness from growing into a long and expensive one. He may detect an incipient condition that, without treatment, might subsequently prove fatal. He will advise as to the rules for healthful living. At the same time, the intelligent individual will want for his family medical prophylactic service against certain catching diseases. Every one should be vaccinated against smallpox at least every seven years. Every child between the ages of six months and ten years should be protected against diphtheria with toxin-antitoxin or toxoid. Typhoid vaccination is also a wise precaution under many circumstances, and we are rapidly learning "vaccination" methods of prevention for other diseases, such as scarlet fever and measles.

Periodic Examination.

When one desires a doctor under any of these conditions, what kind of a physician should one call? How is one to tell whether the physician is competent, reliable, and well trained? Of course, one cannot always determine the professional efficiency and judgment of an individual by arbitrary rule. Still, there are certain standards that can, with wisdom and usually with assurance, be taken into consideration.

One should ask whether the doctor is a man who is liked and trusted by the kind of people whose opinion one respects. Is he a graduate of a recognised medical school that requires a thorough course of training? Has he had broad, practical experience, or training in a first-class hospital, or both? Does he keep in touch with the most recent scientific discoveries? Does he belong to a local or national association of physicians?

Of course the laymen may assume that what he needs is not a regular practitioner of medicine, but a specialist. This assumption may or may not be correct. It should be recognised that a specialist is a man who, in addition to a regular doctor's training, has spent several years studying one branch of medicine or one organ of the body. It is usually wise, however, not to go to a specialist until one has seen a regular doctor for a general examination. He can best tell whether or not a specialist is needed, and can advise the appropriate one to consult.

The Specialist.

It should be remembered that the problem is to choose a man who understands thoroughly the delicate mechanism of the human body. Further, the time to choose him is now. It is certainly not wise to wait until the stress of an emergency, such as an accident or acute illness, makes a deliberate choice difficult if not impossible. Any one moving into a new community should establish a connection with a general practitioner. He should go to him at least once a year for a general medical examination. Such an approach and contact will materially aid the layman in reaching a judgment as to whether the physician is competent not only to advise concerning health, but to care for acute illness as well.

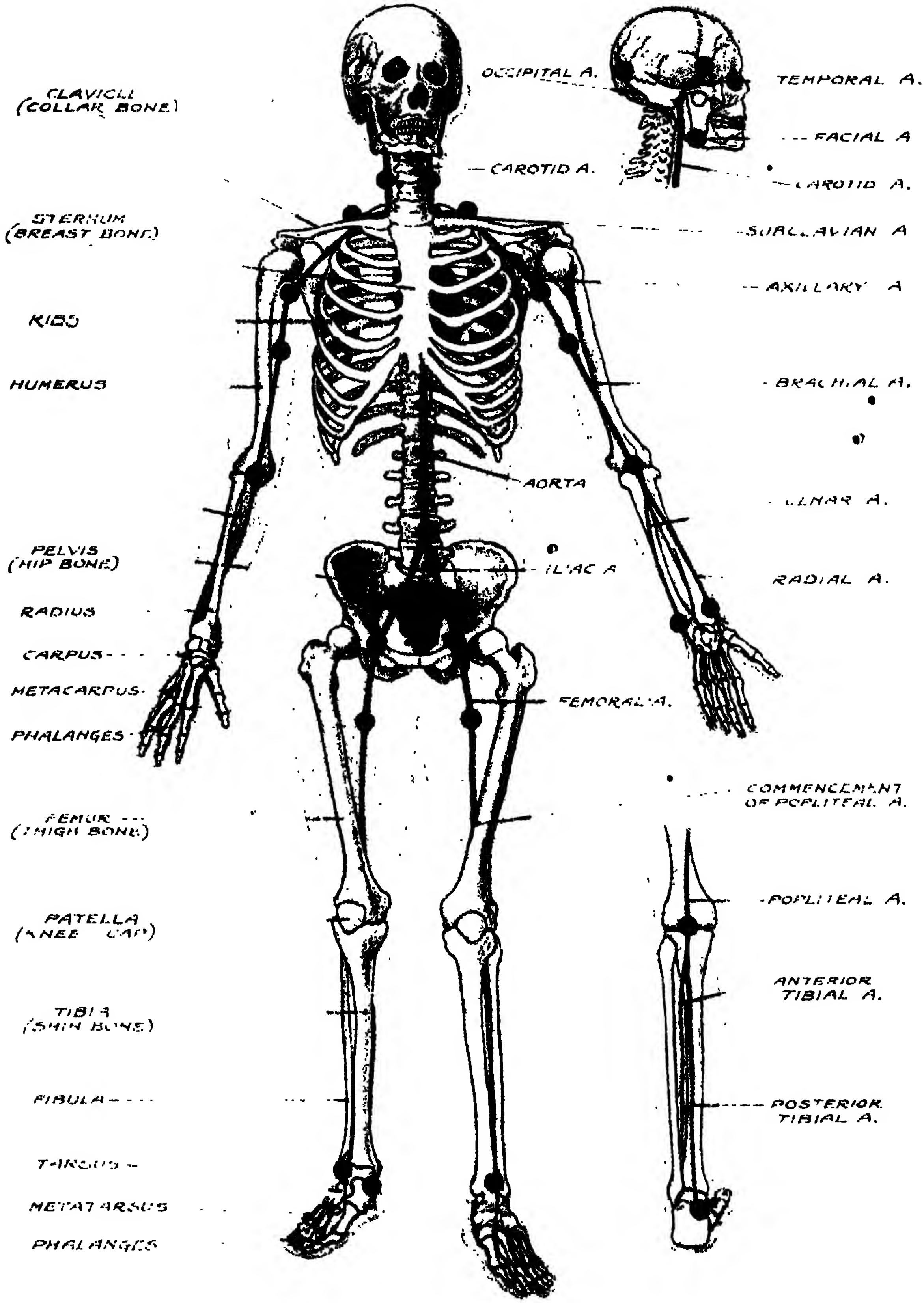
We have touched upon certain of the characteristics of a reliable physician. In contrast, what are the practically universal "ear-marks" of medical quackery? Beware of the doctor who advertises his methods or "cures" in the daily press or who gives out handbills. Beware of the doctor who posts big advertising signboards outside of his office. Beware of the doctor who claims he can cure serious disease quickly and easily. Beware of the travelling doctor who moves from town to town. Beware of the doctor or group of doctors who have discovered some new "cure" about which other physicians are alleged to be unaware. No great discovery of science is kept secret. Remember that the man who makes these

THE VILLAGE DOCTOR
A conception of the "family doctor" of bygone days, from the painting by D. Teniers.

claims or does these things is likely to be a quack.

Of course, for those who cannot afford a private physician, and who are not otherwise cared for through some organised medical procedure, there are free clinics and dispensaries which offer a person the service of a group of doctors, with equipment for scientific treatment. There are, of course, certain quack organisations that also pose under the title of "medical clinic." For that reason, it is safe to patronise only those clinics that are maintained by the health authorities, or by a reputable hospital, or by a medical school, or a well-known private organisation, and it is best to attend these clinics through the recommendation of a regular licensed physician.

Illness is expensive. Sickness costs the people of this country a tremendous amount yearly. In the field of human physical welfare, as practically everywhere else, prevention is less costly than cure. Consequently, every family should maintain a health budget and should make allowances in this budget for keeping the members of the family well. This is wiser than to permit sickness to steal upon one unawares. Is it desirable to spend the allowance in one's sickness or health budget for patent cures and for medicines which the neighbours recommend, or is it preferable to devote this to sound medical advice? Is it better to pay the doctor a little to keep you well, or a lot to care for you when you are ill? The cost of preventive medical advice may involve an initial outlay, but may save money and much suffering in the end. It is wise to select the doctor now and to see him regularly. Most sickness is preventable.



THE BONY SKELETON, ARTERIES AND PRESSURE POINTS.

A guide to the principal bones in the human body, the main arteries and the points (in black) at which pressure should be applied to stop bleeding.

XVII
FIRST AID

By J. H. BARNARD, O.B.E., M.D., Late Physician to the Victoria Home, Paris.

ELEMENTARY PRINCIPLES

UNLIKE Sir Boyle Roche's famous bird, a doctor can lay no claim to ubiquity. It is therefore highly important that the public-spirited citizen should be able, through previous instruction, to render efficient help in the accidents and sudden illnesses that are of such frequent occurrence both in and out of doors. Every medical practitioner knows how many lives are sacrificed owing to the absence of such efficient aid; he also knows how First Aid, wrongly applied in consequence of a faulty appreciation by the layman of the nature of the emergency, may, short of a fatal result, lead to complications that entail a long illness or jeopardise the future happiness or usefulness of the victim. In other words, the help given must proceed from a good Samaritan who knows what he is doing. On these occasions, as in all the affairs of life, sound common sense, based upon sound elementary knowledge, perfectly attainable by a lay person, will prove of inestimable value, and materially facilitate the task of the expert when he arrives on the scene.

This is what Herbert Spencer says about what he denominates the "must-do-something" impulse. "An amiable anxiety to undo or neutralise an evil often prompts to rash courses, as you may see in the hurry with which one who has fallen is snatched up by those at hand; just as though there were danger in letting him lie, which there is not, and no danger in incautiously raising him, which there is. . . . Even among existing physicians it happens that, in proportion as the judgment is most cultivated there is the least yielding to the "must-do-something" impulse." * This

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A ROADSIDE FIRST-AID STATION
First-aid in Surrey, where white cabinets containing dressings and restoratives are fixed to posts in chosen places.

* *Study of Sociology*, pp. 21 and 22.

mischievous impulse must be kept in check. A few rules of conduct to be observed on these occasions will be useful.

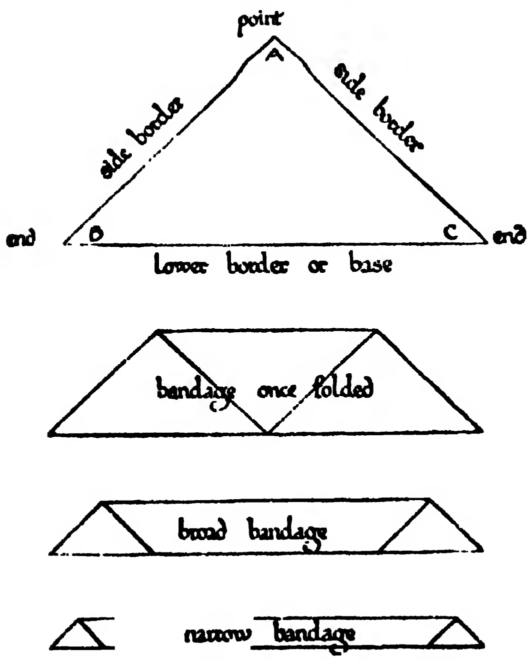
1. **Keep Cool.**—A quiet calm demeanour allays excitement and inspires confidence.

2. **Send for the Doctor**, with, if possible, details of the nature of the case. Do this even if the emergency appears to you to be of a trivial character.

3. **Clear a space around the Sufferer** so as to give him air and in order to give yourself room for your aid-movements.

4. **Take in the Surroundings.**—By so doing, you will often elucidate the cause of the accident, or, in criminal cases, discover a weapon or a bottle in proximity to the patient. Take rapid notice, also, of the sufferer's posture, expression, and the position of the injuries.

5. **Render First Aid.**—For fainting or bleeding keep the head low. Clear the mouth and nostrils of blood, vomited matter or mucus. Run your hand gently along the limbs to detect a possible fracture. If one be detected, avoid rough movements. In a case of external hæmorrhage, arrest it by digital pressure, or by the application of a band (tourniquet). Loosen a tight collar or clothing (belts or corsets).



THE TRIANGULAR BANDAGE
Explaining the terms used with this bandage and the method of folding it.

6. **Give further Aid** if the doctor has not arrived. Should the sufferer feel cold or be shivering, apply hot bottles or heated bricks protected by flannel, or cover him with a hot blanket. Avoid alcohol. If the patient be collapsed but conscious, a small teaspoonful of sal volatile in half a tumblerful of cold water, a cup of hot coffee or milk may be administered.

7. **Examine the Patient.**—If he be conscious, he can supply useful information. Remove him under cover, if possible. In case of injury to a limb, remove the clothing from the uninjured side first, then if necessary cut or rip down the seam on the injured side. Cut the boot off the injured leg if it will not slip off easily. To reapply the clothing, replace it first on the injured side. Should the patient be unconscious, and the doctor's arrival be delayed, examine further for the possible cause, beginning with the scalp (seek wounds, swellings, depressions of the skull), running your *cleansed* fingers on each side for comparison. Examine both eyes, notice if the pupils are contracted to a pin-point, or dilated, and if their size is the same in each eye. Also notice if, on lifting the upper eyelid, they contract on admission of light. Run your hand down the spine and note any irregularities. See if the cheeks flap or are puffed out on breathing, and examine the jaw for a fracture. In the same way examine the ribs for irregularities, tender spots, or grating, and seek wounds of the body, back and front.

The First-Aider should possess a general knowledge of the significance of the symptoms and signs of ordinary emergencies. (A symptom is what the patient complains of; a sign is anything unusual the observer notices in the body or functions of the sufferer).

Unconsciousness shows that the brain is not functioning properly. A **cold, clammy skin**, with drops of sweat standing upon it, and a rapid, weak pulse, mean that the sufferer is in a serious condition. A **flushed, congested face** is a frequent sign of a stroke (cerebral hæmorrhage),

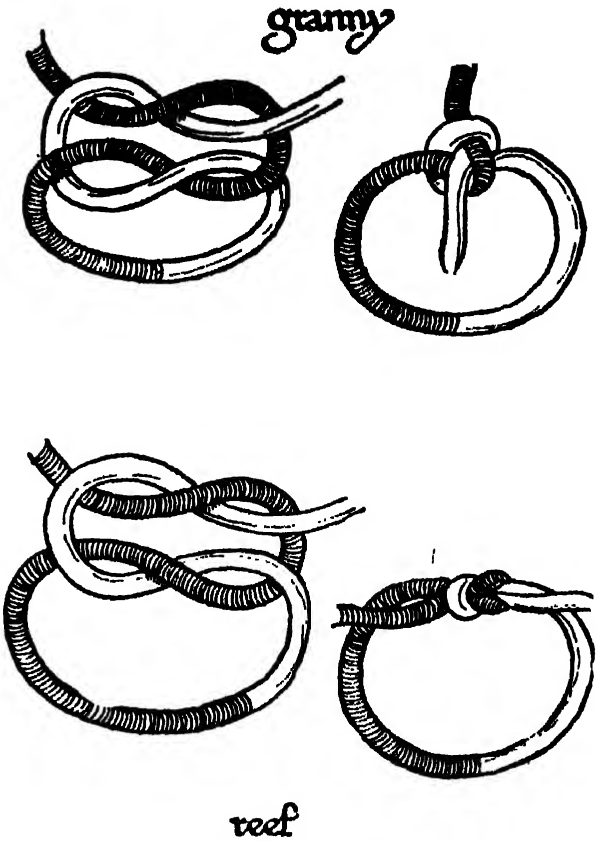
of fever and of a drunken state. POWERLESS LIMBS (arm and leg on one side of the body), in the absence of fracture, mean paralysis, and, if appearing suddenly and associated with unconsciousness, are significant of the rupture of a blood-vessel in the brain. DILATED PUPILS with unconsciousness may mean poisoning (*e.g.* with belladonna) or severe shock (if they contract with light), or pressure on the brain. CONTRACTED PUPILS may mean poisoning with opium or morphia, or hæmorrhage into a part of the brain called the pons varolii. Flapping, stertorous, NOISY BREATHING means total unconsciousness (coma). If bright-red, frothy BLOOD be COUGHED UP, it comes from the lung; if it be bright or dark and is VOMITED, the source is the stomach, gullet, nose or mouth. BLEEDING FROM THE EAR, mouth or nose after an injury to the head generally means a fractured skull.

VOMITING may mean "indigestion," kidney disease, brain tumour (in this case there is no nausea), a blow on the abdomen, onset in a child of an infectious fever (measles, scarlet fever), pregnancy (morning sickness), alcoholism, gastric ulcer or obstruction of the bowels.

FAINTING may be caused by fright, acute pain, internal or external bleeding, heat, exhaustion, and means a temporary heart-failure with consequent diminished supply of blood to the brain.

A SLOW PULSE may be normal, but may be significant of brain-pressure or opium poisoning. A RAPID PULSE may be due to fever, emotion, fright, hæmorrhage, or heart disease.

CONVULSIONS in infants may be due to bowel disturbance or to the onset of scarlet fever, measles, or other fevers. In adults, they may mean kidney disease, epilepsy or hysteria, or they may be feigned.



THE REEF KNOT
Showing (*above*) the wrong way, and (*below*) the right way to tie a simple knot in bandaging. The reef knot is firmer and lies flat.

DIFFICULTY OF BREATHING may be due to a variety of causes; heart or lung disease, or brain or throat affections. In children, a foreign body may be lodged in the larynx, or the disease may be croup, where a membrane forms in the air-passages.

These signs and symptoms will be mentioned in greater detail in later sections. In conclusion, never forget that, while intelligent First Aid is highly useful, meddlesome First Aid is injurious. Our motto should be: *primum non nocere*: "*ABOVE ALL, DO NO HARM.*"

BANDAGING

THE TRIANGULAR BANDAGE

THE study of First Aid may be commenced by a description of the Triangular Bandage. This is the most useful form of bandage for First Aid purposes, satisfying all requirements excepting in cases requiring pressure (as in bleeding). In these cases, recourse must be had to the roller bandage. This demands some skill in its application; the triangular

LEAVING THE SHOULDER FREE
When pressure must not be applied to the shoulder of the injured side, the lower end of the bandage is passed under the arm to tie behind.

bandage is, consequently, more suitable in the hands of the amateur for the majority of accidents.

The triangular bandage is easily made from a square of any material such as linen, calico, muslin, gauze, etc., or a large muffler. Each side must measure forty inches in length. Fold such a square diagonally, cut it along the fold and the bandage is made. The base of the triangle is called the Lower Border; the two sides of the triangle the Side Borders; the apex is named the Point and the corners the Ends.

Application.

The triangular bandage can be applied (*a*) unfolded; (*b*) folded broad; (*c*) folded narrow. (*b*) is prepared by carrying the point of the spread-out bandage down to the centre of the lower border and folding it lengthwise upon itself *once*. (*c*) is obtained by folding (*b*) lengthwise upon itself *once*.

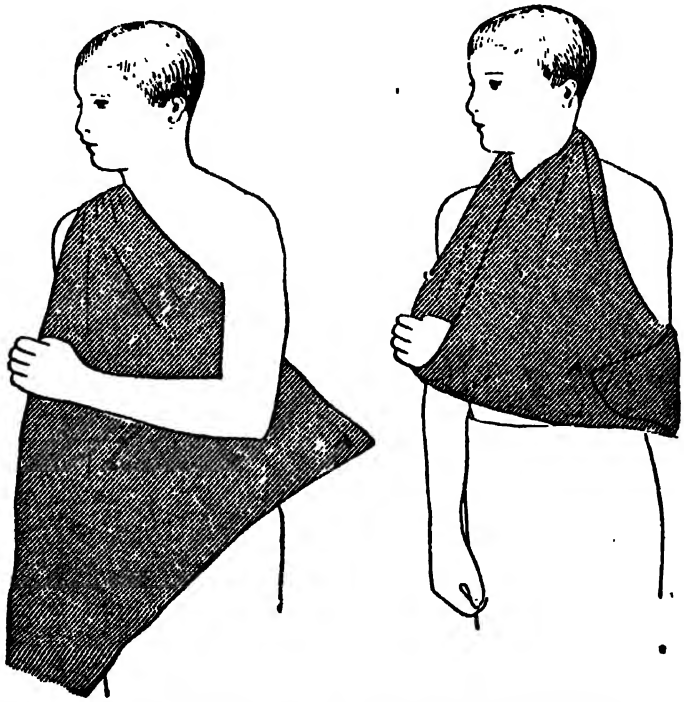
To secure the ends of the bandage after its application, use a safety pin, or tie a reef (sailor's) knot, avoiding a "granny," which is less firm and is liable to become untied. The REEF KNOT is made in a way readily explained by the diagrams on page 1107.

Observe that in the reef knot, both the ends of the thread or bandage pass either over or under the corresponding loop, while in the "granny" one thread is over and the other under. The secret in making a reef knot is to make the same thread uppermost or undermost both in the first and second

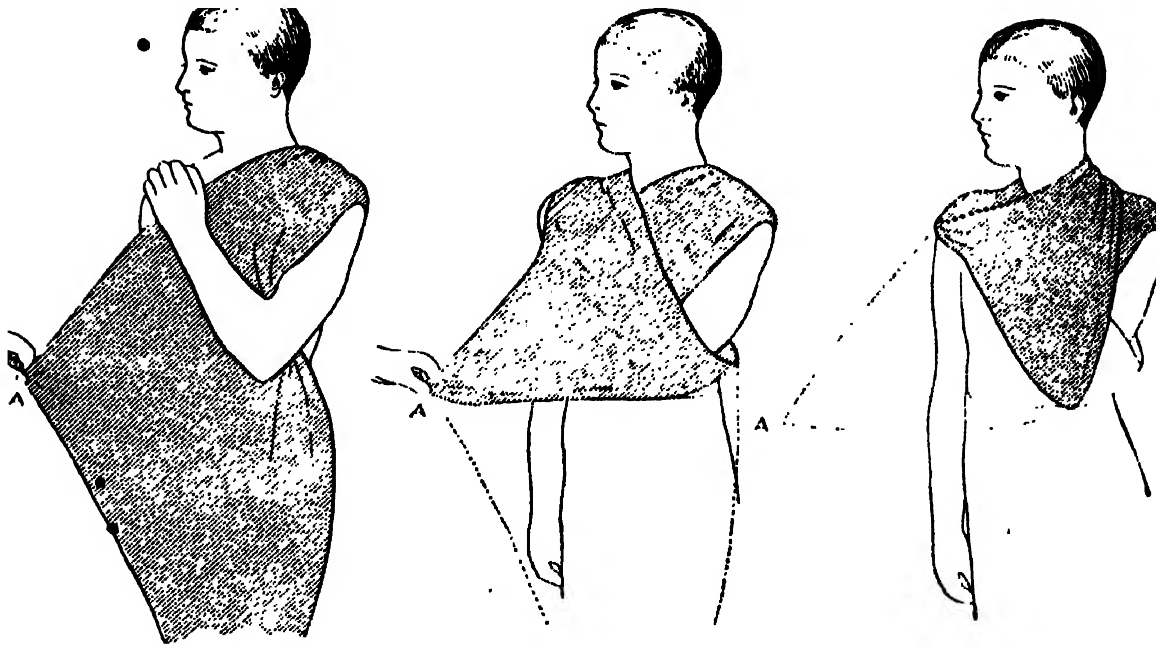
The following slings may be made with the triangular bandage :—

(*a*) THE NARROW ARM-SLING. Fold the bandage *narrow*, place one end over the uninjured shoulder with the other end hanging down in front of the chest. Flex the forearm to the required angle, draw up the hanging end in front of it and over the shoulder of the injured side and then tie the two ends below the collar-bone of the injured side.

(*b*) THE BROAD ARM-SLING. Fold the triangular bandage *broad* and apply in the same way as the preceding.



A BROAD SLING FOR THE FOREARM
The lower end of the bandage is drawn up in front of the forearm, over the shoulder of the injured side, and tied to the other end at the back.



HOW TO SUPPORT THE ELBOW

One end of the bandage is taken over the shoulder on the injured side: the lower end is then brought over the bent forearm on the uninjured side and tied to the other end; finally point A is secured at the back with a safety pin.

The broad arm-sling may be used for two purposes: (*a*) TO SUPPORT THE FOREARM. Place the point of the triangular bandage (unfolded) below and beyond the elbow of the injured side and the upper end over the opposite shoulder. Flex the forearm across the chest, draw up the hanging lower end in front of the forearm over the shoulder of the injured side and tie the two ends below the collar-bone of the injured side. Draw the point forwards over the elbow and secure it with a safety pin to the bandage in front.

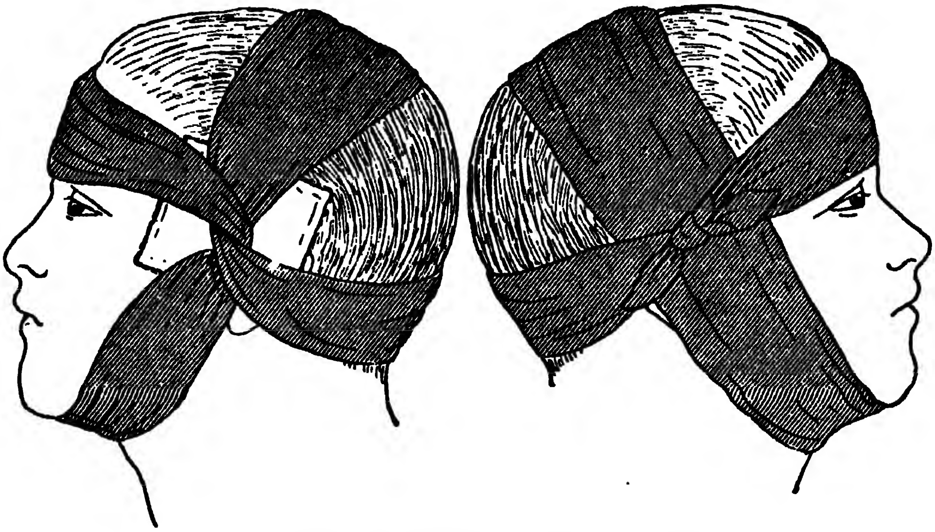
(*b*) TO SUPPORT THE ELBOW. Place one end of the bandage over the shoulder of the injured side with the point in the direction opposite to the elbow. Bend the forearm on the injured side across the chest with the fingers on the opposite shoulder. Draw the lower end of the bandage across the arm to the top of the shoulder on the uninjured side and tie it to the upper end. Fold the point over the arm and secure it with a safety pin to the bandage above on the injured side.

If in (*a*) sling it be not advisable to apply pressure on the shoulder of the injured side, pass the lower end between the injured arm and the body, and tie it to the end passed over the uninjured shoulder.

In burns, scalds or wounds of different regions, the triangular bandage may be used to retain dressings.

For a SCALP WOUND, the bandage can be applied in two ways: (*a*) Place the lower border below the occipital protuberance (the bump at the back of the skull), and draw the point forward over the forehead. Now draw the ends around the sides of the head *above* the ears, and knot them over the forehead, turning up and pinning the point.

(*b*) This is a neater method. Along the lower border of the bandage turn up a hem about $1\frac{1}{2}$ inches deep. Lay the bandage on the head so that the hem lies on the forehead as close to the eyebrows as possible without covering the eyes. The point will thus hang down behind the head over the nape of the neck. Now carry the two ends round the head above the ears, cross them, carry forward and tie them together over the forehead. Give the point a pull downwards



TRIANGULAR BANDAGES FOR THE HEAD (I.)
Two views of a triangular bandage applied to support dressings on a temple wound.

so as to render the bandage over the head taut, then turn it up and secure with a safety pin.

For wounds of the forehead, back of the head, chin, ears, cheeks, or of the arm or thigh, use a narrow bandage as follows :—

WOUNDS OF BACK OF THE HEAD OR FOREHEAD. Place the centre of the bandage over the dressing on the wound, carry the ends around the head, cross them, and bringing them backwards or forwards as the case may be, tie them together over the site of the wound.

WOUNDS OF THE TEMPLE. The centre of the narrow bandage being placed on the *unwounded* temple, carry the ends, one up over the head and one down under the jaw. Cross them over the dressing on the wound, carry them around the head, knotting them on the sound temple.

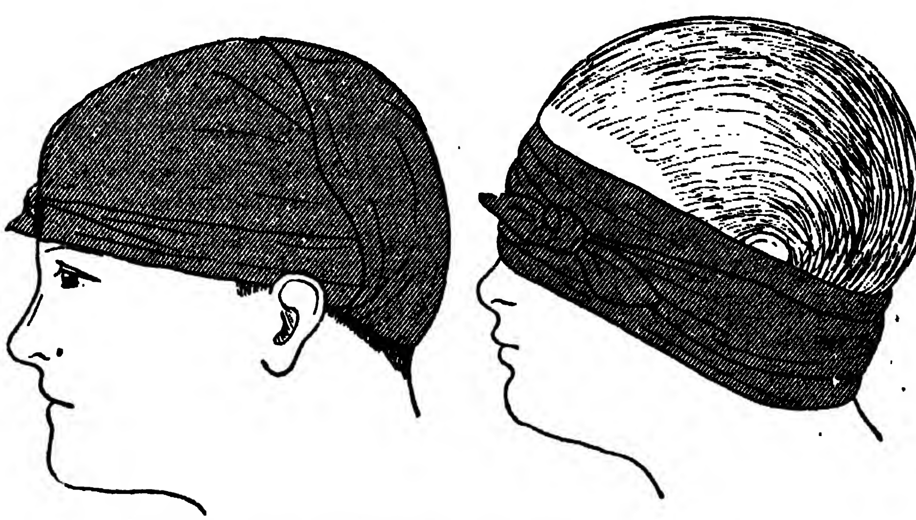
WOUNDS OF CHIN, EARS AND FACE. With the centre of the narrow bandage under the chin, carry the ends up towards the top of the head ; cross them just above the ear and carry the ends round temples to tie at the side of the head.

WOUNDS OF BOTH EYES. The centre of the narrow bandage being applied on the bridge of the nose, bring the ends backwards and then forward, and tie in front.

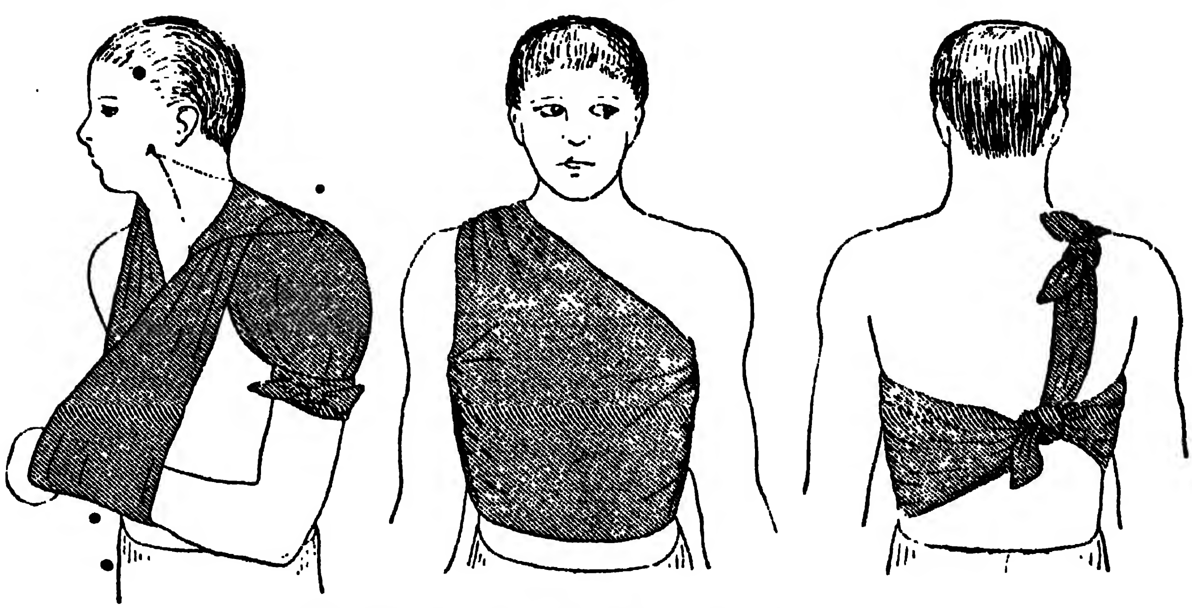
WOUND OF ONE EYE. The centre of the narrow bandage being placed over the dressing on the wounded eye, bring the ends obliquely, one up over the forehead and one down over the ear, cross them behind well under the occipital bump, carry them forward and knot over the dressing on the injured eye.

WOUND OF THE NECK. The centre of the bandage being placed over the dressing on the wound, carry the ends around the neck, cross them and bring them back to tie over the dressing.

WOUND OF THE SHOULDER. Here use the



TRIANGULAR BANDAGES FOR THE HEAD (II. and III.)
Left--A scalp wound with the bandage applied by method (*b*), (see text page 1109).
Right—A triangular bandage for the eye.



BANDAGING FOR THE SHOULDER AND CHEST

The triangular bandage is used unfolded in these positions. For a wound of the shoulder (*left*) a narrow arm-sling is also necessary, and point A of the bandage is looped through it.

unfolded bandage. Apply the centre on the most prominent part of the shoulder, the point being upwards and the lower border across the arm. Bring the ends around the arm, cross them on its inner side, carry them forward and knot them together on the outside of the limb. Apply a narrow arm-sling to the forearm, carry the point of the bandage under the sling, fold it back and pin it on the shoulder.

WOUNDS OF THE CHEST. The centre of the unfolded bandage being over the front of the chest with the point over the shoulder of the injured side, carry the ends around the chest, and knot them together, leaving one long end which is now tied behind to the point brought over the shoulder.

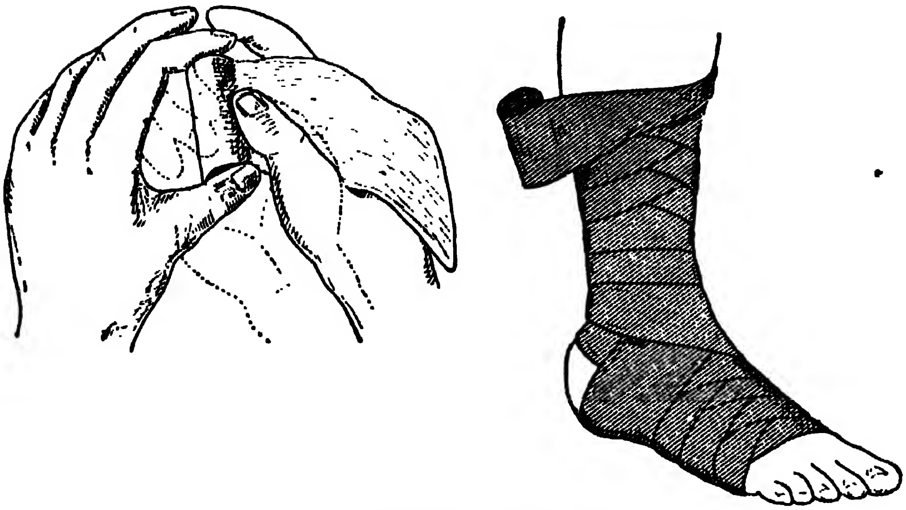
THE ROLLER BANDAGE

This kind of bandage need be used only when firm pressure has to be applied, as, for instance, in the control of hæmorrhage. It is a double-edged weapon, for in inexperienced hands, excessive and harmful compression is apt to be exerted.

The roller bandage can be improvised by tearing or cutting strips from gauze, muslin, or from a tablecloth, sheet, petticoat, etc. The width of each strip for bandaging a limb is from 2½ to 3 inches, and the length from 6 to 12 yards. For a finger, the figures should be ¾ of an inch and 1 or 2 yards. Before using it, it should be tightly rolled. To do this, remove the ravellings, fold about 1½ feet of one end repeatedly upon itself until it is reduced to a length of 3 inches. Roll this tightly with the finger and thumb so as to make a firm cylinder. To quote Dr. Eliason *: "grasp the roller between the thumb and index finger of the left hand, the body of the roll being beneath and the free end passing over the index finger between it and the thumb of the right hand. Holding the roll firmly with the left hand, allowing the free portion of the bandage to slip through the right hand, turn both hands palm upwards; then, grasping the roll between the thumb base and the fourth and fifth fingers of the right hand, release pressure of the left finger and thumb, turning both hands backwards. Repetition of these movements rolls the bandage."

The bandage may also be rolled on a flat surface. Place the rolled cylinder on a flat surface, the free end being next the surface and trailing away from you. Then by gentle pressure on the roll, the fingers are

* *First Aid in Emergencies.*



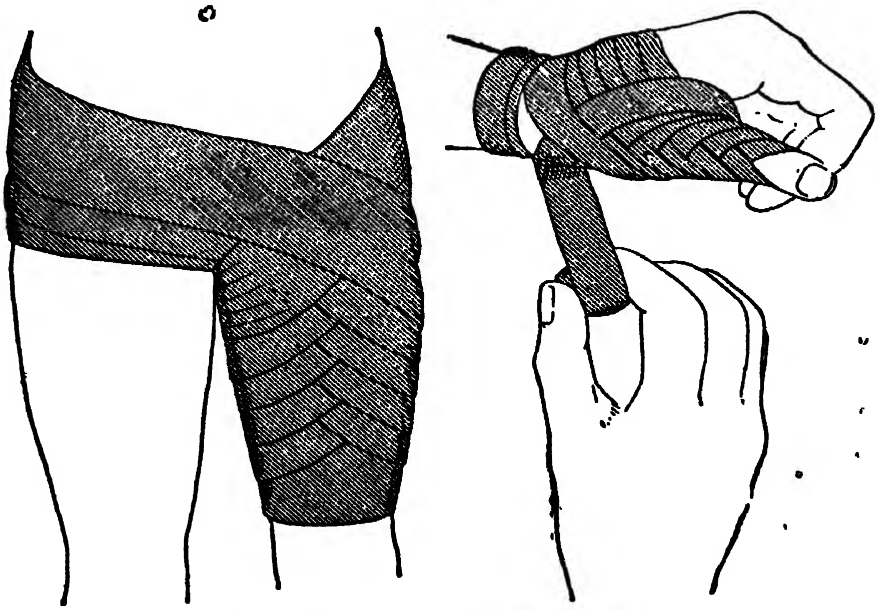
THE ROLLER BANDAGE
Left—How to roll an improvised or loose bandage ready for application. *Right*—A roller bandage applied as (1) a reverse spiral (on the foot); (2) a figure-of-eight (on the ankle); and (3) a plain spiral changing to a reverse (on the leg).

pushed forward in the direction of the free end of the strip, thus rolling the bandage. Repeat as often as necessary.

In applying a roller bandage, stand in front of the limb. If the leg is to be bandaged, keep it extended; if the arm, bend the elbow, placing the arm with the thumb upwards. Now apply the *outside* of the roll obliquely to the inside of the limb, make two circular turns to fix the bandage, all this being done at the *lower* part of the limb. Now proceed to bandage (*from below upwards*, and always *from within outwards*) over the front of the arm or leg, being careful not to unroll more than three inches of the roll at a time. Each turn of the bandage should overlap two-thirds of the one covered. In each turn, avoid excessive looseness or tightness, using uniform firm pressure. If the finger or toe-tips become blue and cold after the application of the bandage, it shows that the bandage has been too tightly applied at one or more turns; in this case, loosen the bandage at once. The margins of the turns should lie parallel and not pocket. Over a joint or a bony prominence form a figure of eight and not a reverse. It is dangerous to apply a bandage wet, as the material shrinks as it dries and becomes too tight. When the limb is bandaged, secure the end with a safety pin.

The roller bandage may be applied as a circular bandage, a simple spiral bandage, a reverse spiral bandage or a figure-of-eight.

In the application of the roller bandage, grasp the roll in one hand, the right for the left limb, the left for the right limb, and, taking the loose end in the other, apply it to the limb with the *outer surface* against the skin.



APPLYING THE SPICA BANDAGE
The Spica bandage, a modification of the figure-of-eight, can be applied to the groin, shoulder or thumb.

[Topical

ATTENDING TO A "CASUALTY"
A demonstration of First-Aid Work during a competition for the Railway Ambulance Shield.

The CIRCULAR BANDAGE requires no description.

The SIMPLE SPIRAL bandage is limited in its application to cylindrical surfaces such as the fingers and the forearm just above the wrist. No reverses are required.

The REVERSE SPIRAL BANDAGE is used when, owing to the enlargement of the limbs at the upper parts (forearm, calf, etc), the turns of the simple spiral have to be replaced by what are called reverses (folds of the bandage on itself) in order to lie smoothly. To make these turns or reverses, if the following three conditions be observed no difficulty will be experienced. (1) A turn should be on the *outside* of a limb, and never over a bony prominence. (2) However tightly the bandage may have been drawn before, when the turn is made, it should be held quite loosely. A quick movement of the wrist forms the reverse or turn, and then the requisite tightness can be applied. (3) In effecting the turn, hold the hand slightly above the level of the limb, being careful not to unroll more bandage than is required for making the turn.

The FIGURE-OF-EIGHT BANDAGE is very suitable for the joints; its nature is sufficiently indicated by the name.

A combination of the simple spiral, reverse spiral and figure-of-eight is frequently useful as in the appended figure where the reverse spiral is used for the foot, the figure-of-eight for the ankle, and the plain spiral is changed to the reverse spiral for the leg.

The SPICA BANDAGE, a modification of the figure-of-eight, is used for the groin, the shoulder or thumb. To apply it to the groin, bend the hip, take two spiral turns on the upper part of the thigh, change to the reverse spiral till the groin is reached, then carry the bandage across the front of the groin outwards and upwards to above the hip joint, then across the back and over the

other hip and across the pubes back to the affected groin. Then carry the bandage to the outside of the thigh around the back of it to the inside and over the groin and then across the body. The figures on page 1112 will explain the *modus operandi.*

HÆMORRHAGE (BLEEDING)

BY "hæmorrhage" is meant an escape of blood from the blood-vessels whether of a slight character and ceasing spontaneously, or of a serious nature and requiring treatment for its arrest. It may be due to either injury or disease. Thus, in the diseases called purpura and scorbutus (scurvy) there is a pronounced tendency to bleeding. In a congenital condition called hæmophilia, occurring in males though transmitted by females, even trifling bleeding, once started, is difficult to control. These are the persons known as "bleeders."

The character of the hæmorrhage differs according to its source. When ARTERIAL, the most dangerous, the blood *spurts in jets*, each jet coinciding with a beat of the heart, the stream being *bright red.* The flow of blood may be derived not only from the severed end of the artery nearer to the heart, but also from the distant end, this latter being due to free collateral circulation. If, however, the bleeding be from a deep artery, the blood may well up from the depths of the wound, and not in gushes.

In VENOUS hæmorrhage, the flow is generally *continuous*, the blood being of a *dark colour*, or almost black. If, however, a large vein, such as the internal jugular, be wounded, the blood may issue with a pronounced spurt, owing to the influence of the respiration.

CAPILLARY hæmorrhage is distinguished by a *general oozing* from a raw surface, the blood filling the wound from below upwards.

By EXTRAVASATION OF BLOOD is meant the flow of blood from a wounded vessel (or vessels), not externally, but into the loose fatty tissue under the skin, which becomes boggy and swollen. This variety may be so extensive as to cause serious symptoms characteristic of loss of blood; it may even cause death.

EPISTAXIS is nose-bleeding.

In VOMITING OF BLOOD (hæmatemesis) the blood may have been swallowed, as in some cases of fracture of the base of the skull where the mucous membrane of the pharynx has been torn. The bleeding may proceed from varicose veins of the lower part of the gullet, or the blood may come from the stomach. If the blood has been in the stomach for some time, it becomes curdled and brown in colour, rather like coffee-grounds, owing to the action of the gastric juice. When the hæmorrhage is more active, the blood is bright red, and may be vomited in large clots.

HÆMOPTYSIS is the name given to the escape of blood from the air-passages, the result of either disease or injury. In mild cases, the blood is *bright-red* and *frothy* from admixture of air; in serious cases, where large vessels are ruptured, the blood may escape unaltered, and, if very abundant, may asphyxiate the patient. Hæmoptysis is most frequently seen in cases of phthisis.

In HÆMATURIA, the blood is passed in the urine. The blood may come from any of the urinary organs, and its significance varies. If it comes from the kidney it is mixed throughout the urine, which is "smoky" when passsed, a state of affairs often seen in acute Bright's disease. The passing of bright red blood is sometimes a sign of a bladder tumour, while injury to the urethra may be accompanied by the appearance of blood clots which are washed out as the urine is voided.

IN MELAENA the dejections from the bowel are mixed with dark, tarry blood. This signifies bleeding sufficiently far away from the bowel-orifice to allow the blood to be altered by the intestinal juices. If the source be the mucous membrane of the rectum the blood is bright-red.

In very severe bleeding, as from the severance of a large artery, death ensues from heart failure. The skin is pale, cold

FIRST-AID IN VENOUS HÆMORRHAGE

Left—Applying pressure with a sterilised finger over a pad of wool to stop bleeding. *Right*—Bandaging the leg from below upwards. The limb is kept raised, and garters, etc., that might hinder the return of blood to the heart, are loosened.

and clammy, the ears and lips blue. There is gasping, quick and sighing respiration, and, just before death, there may be some convulsive twitching of the limbs. Should the bleeding not lead to speedy death, there is fainting: on recovery from this, the sufferer is in a state of collapse and weakness which lasts for a certain time; he may also have some more fainting fits, more especially if the bleeding recurs. Should the hæmorrhage be concealed and visceral (in an internal organ), the patient rapidly becomes very anæmic with a drawn and shrunken face. The patient feels suffocated and is restless and clamours for air, continually asking his friends to open the windows (air-hunger). The slightest movement may cause fainting; he complains of noises in the ears and of dimness of sight or even temporary blindness. The pulse becomes hæmorrhagic, *i.e.* frequent and compressible, collapsing entirely between the beats and may disappear at the wrist if bleeding continues.

Effects on the System.

Elderly people and children are very intolerant of loss of blood, but the latter differ from the former in that they quickly recover from the immediate effects.

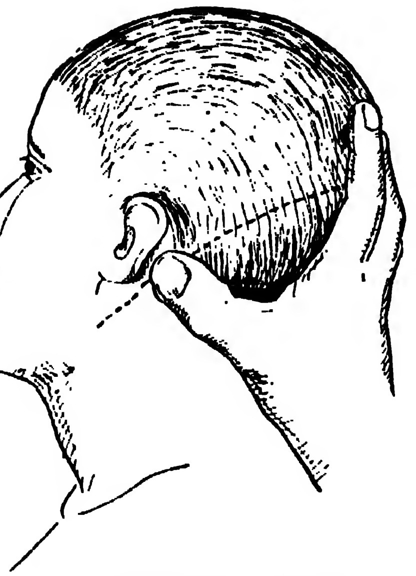
General Treatment.

When the blood lost has been abundant, keep the patient quiet and with the head low, even if there be no sign of fainting. The best way to do this is to raise the foot of the bed on blocks. The object of this is to keep the brain supplied with blood. *Stimulants* (brandy, etc.), ***should never be administered before the hæmorrhage has been controlled.*** Given before this has been done, they will probably restart or increase the bleeding. If the patient appears to be dying, bandage the arms and legs from below upwards so as to confine the blood as much as possible to the nerve-centres and trunk.

Nature's way of arresting bleeding is substantially the same for wounds of arteries, veins or capillaries, although the following remarks apply more especially to the most dangerous variety—viz., arterial hæmorrhage.

The temporary arrest of arterial hæmorrhage is effected in three ways:—

(1) The formation of a clot in and around the artery. If this failed, the most trifling wound of a vessel would entail death. This power of clotting is variable in different

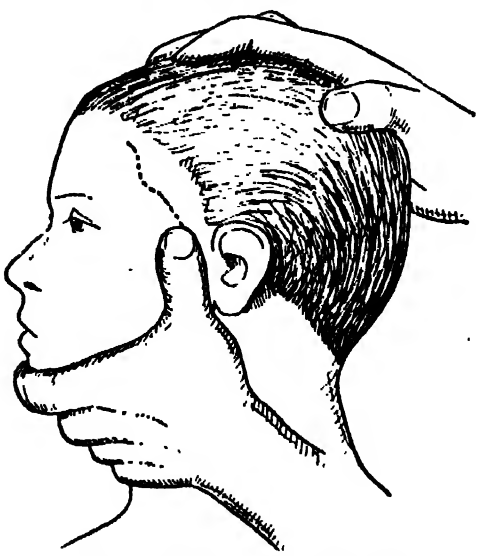


THE OCCIPITAL ARTERY
Showing the point where finger pressure should be applied when bleeding from this artery occurs.

persons, being dependent on several conditions. Of these conditions, the one concerning which there can be no contest is the presence in the blood of calcium compounds. If these be removed by the addition to the blood of an alkaline oxalate, fluoride or citrate, coagulation does not take place. If, after this decalcification, the lime salts be restored to the blood, the clotting will be renewed. In hæmophilics (bleeders), clotting takes place with difficulty, and this constitutes the danger of the slightest operation in such persons. As the blood continues to flow in hæmorrhage, its coagulability increases to a certain extent.

(2) A weakening of the heart's action is a constant accompaniment of hæmorrhage owing to a deficient supply of blood to the brain. This encourages clotting and so tends to arrest the flow. This explains why *stimulants should never be given until the severed vessel has been tied. The First-Aider should, therefore, never give alcohol in these cases.*

(3) Changes in and around the injured artery are of great importance. When an artery is divided, it retracts within its sheath owing to its own elasticity. The retraction exposes the rough, uneven inner lining of the sheath enclosing the artery. Upon this rough surface the blood clots, forming what is called the external coagulum (clot). While this is occurring, the muscular and elastic fibres in the middle coat of the vessel produce contraction of its open mouth. The weakening heart-beats allow this external clot to extend, the sheath becoming full of it until it reaches the mouth of the vessel. Now an internal coagulum forms; this sometimes extends upwards as far as the point where the nearest branch of the artery arises. These natural means having provided for the *temporary* arrest of the hæmorrhage, the next step is the permanent closure of the wound in the vessel. This is brought about by a reparative process such as occurs in any wound, the part of the artery occupied by the internal clot being ultimately (in a few months) obliterated and converted into a fibrous cord. The arrest of bleeding from veins and capillaries is an easier process, the collapse of their walls and the much lower blood-pressure facilitating the task.



THE TEMPORAL ARTERY
The pressure point is just in front of the ear-orifice. (*See page* 1119.)

FIRST AID IN EXTERNAL HÆMORRHAGE

Capillary Hæmorrhage.

In Capillary Hæmorrhage, having first raised the part, if possible, above the heart-level, remove all dressings from the wound, apply on it a *clean* pad of gauze, lint or linen, and press gently on the pad with a *cleansed*

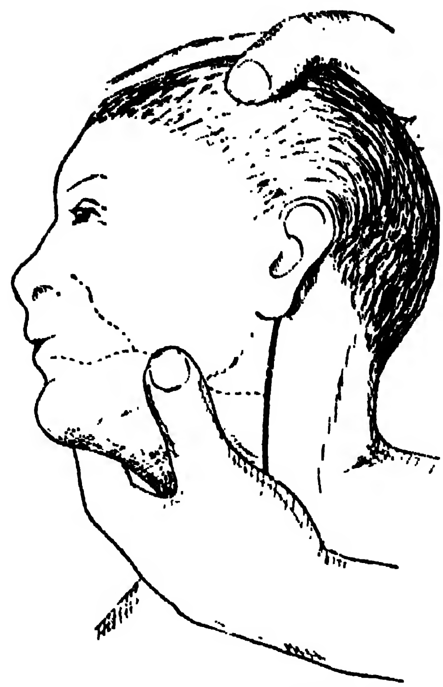
finger. Should the oozing still continue, pour a stream of hot water (130° to 160°F.) on the wound. If a bath thermometer be not available, pour on the wound water previously boiled and iced by surrounding, not added, ice. The use of styptics is not to be recommended. It is always advisable to clean the neighbourhood of a wound with a dossil of clean cotton wool dipped in water previously boiled and allowed to cool; clean in a direction *away* from the wound. After drying thoroughly with cotton wool, paint all the cleansed part with tincture of iodine, avoiding the immediate neighbourhood of the wound. A 2 per cent. solution of iodine in rectified (not methylated) spirit is preferable. This should also be painted on the previously washed fingers of the First-Aider before he begins his ministrations. On no account should it be forgotten that fingers, skin, etc., considered socially clean, require to be rendered *surgically clean* (a very different thing) before coming in contact with breaches of the skin surface.

Should the wound be dirty and the doctor's arrival be delayed, cleanse it with cold previously-boiled water before painting the neighbouring parts with the iodine solution.

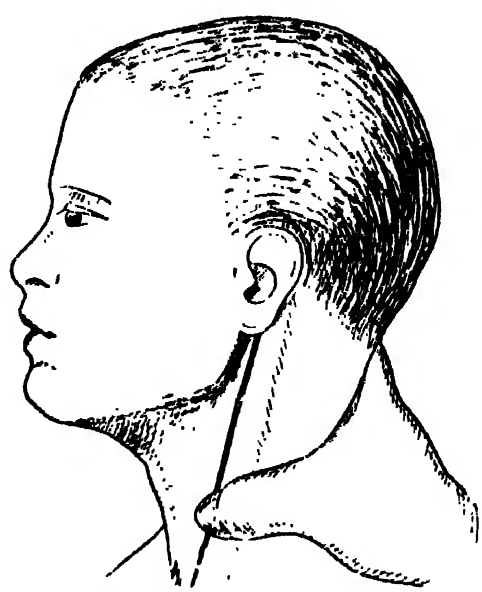
Venous Hæmorrhage.

In Venous Hæmorrhage, loosen belts, collars, garters and clothing that may impede the return of venous blood to the heart, the patient being, of course, recumbent. Raise the part above the heart-level, then apply on the bleeding point *digital (finger) pressure* with a cleansed then iodised finger over a sterile pad of gauze or wool. Apply a roller bandage over the pad, from below upwards, if a limb, and keep the part raised.

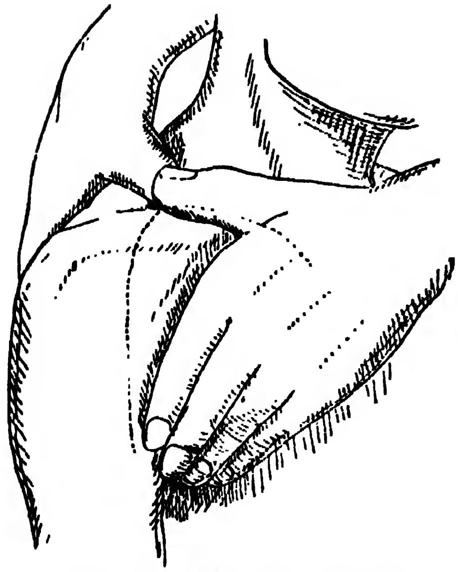
A BURST VARICOSE VEIN in the leg, the valves in which vein are rendered incompetent by disease, is the source of abundant or even fatal hæmorrhage, which is, however, easily controlled. Lay the patient on his back, raise the leg two feet above the horizontal, remove the garter, if worn, and also any constriction between the bleeding vein and the heart. Having exposed the bleeding point, place a sterile pad on the wound (gauze, cotton wool) and apply over it first the finger then a roller bandage. Remove the patient, if that be necessary, on a stretcher with his leg raised, and keep him warm, more particularly if the bleeding has been severe.



THE FACIAL ARTERIES
Both facial arteries can be compressed with thumb and forefinger against the lower jaw.



COMMON CAROTID ARTERY.
Press this artery backwards and inwards with the thumb.



THE SUBCLAVIAN ARTERY
Both thumbs are used, one over the other, to press the artery backwards and downwards behind the middle of the clavicle.

The principal indications in the immediate arrest of Arterial Hæmorrhage are to *raise the part*, remove all constrictions between the wound and the heart, expose the wound and apply *digital pressure*. The digital pressure may be applied to the wound or over the main artery between it and the heart. Having done this, and keeping the patient lying down, the further measures to be taken will depend, as to their character, on the degree of severity of the hæmorrhage.

Arterial Hæmorrhage.

If the bleeding be moderate, firm digital pressure on the wound itself with cleansed fingers will arrest the flow, when a sterile pad can be applied and secured in place by a triangular or a roller bandage firmly applied. In a wound of the PALMAR ARCH, pressure must be applied by a graduated compress composed of superposed layers of sterile gauze or lint, the layer next the wound being small and the rest becoming gradually larger till the most superficial attains the size of a shilling. The elbow is then flexed and the hand fixed up to the opposite shoulder.

If the bleeding be alarming, apply digital pressure to the main artery between the wound and the heart. The pressure should, if possible, be applied against a bone, which, in the limbs, lies always alongside. This, when properly applied, is always and promptly efficacious. The thumb, reinforced sometimes by the other thumb superposed, should generally be used as the compressing force. This presses the artery against the bone, *only sufficient force being employed to stop the bleeding*, and avoiding any pressure that causes pain. Pain will be absent if the thumb presses only the artery, to the exclusion of the surrounding structures (nerves, veins, etc.).

Digital pressure is limited in its scope by its fatiguing nature (ten to fifteen minutes is the longest séance possible for one person). It is, moreover, not available for all parts of the body, its applicability being limited to the neck, the scalp, the face, the jaw and the limbs.

When digital pressure has been maintained for some time, it can be replaced by a tourniquet.

The following arteries are amenable to digital pressure :—

The Arteries of the Head and Neck, since in scalp wounds the bones of the skull supply a firm resisting surface for digital compression. The intercommunications of the arteries of the scalp are so extensive that pressure on the main

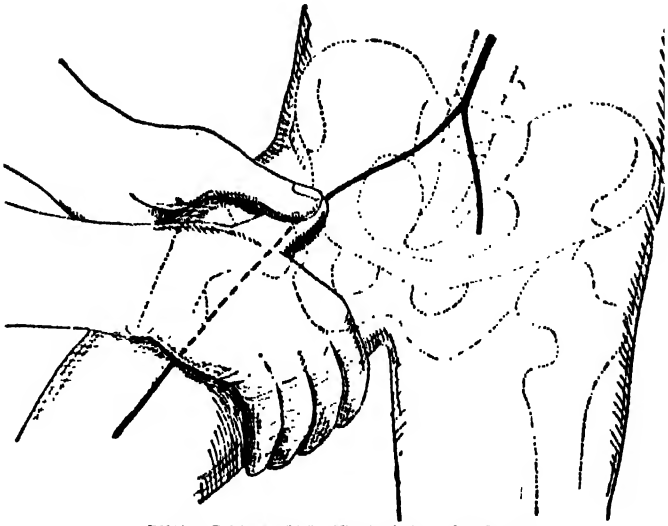
Pressure Points.

THE AXILLARY ARTERY
Use four fingers to press the artery against the humerus, the patient's arm being raised.

trunks (occipital, temporal) is not always efficacious in arresting bleeding. Sometimes, however, this compression of the main artery suffices.

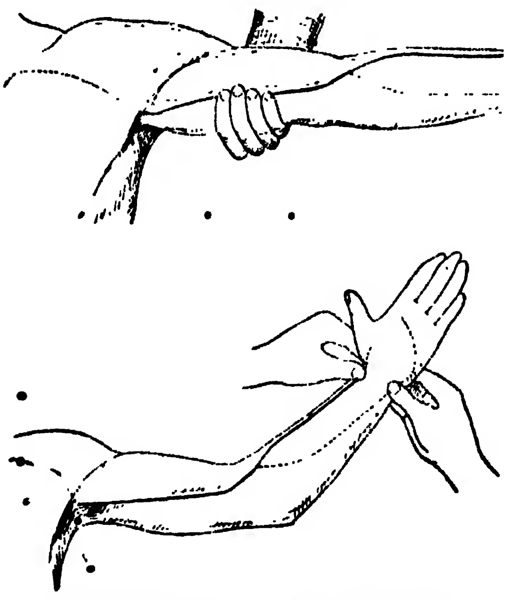
The Occipital Artery may be compressed half an inch behind the base of the prominence (mastoid process) behind the ear, or two fingers breadth behind the middle of the back of the ear. Press directly backwards.

The Temporal Artery may be easily compressed against the zygoma as it passes over it just in front of the ear-orifice.



THE COMMON FEMORAL ARTERY
The thigh must be rotated outwards and the two thumbs, superposed, applied to the middle of the groin.

The Arteries of the Face, like the vessels of the scalp, intercommunicate so freely that direct pressure over the bleeding point is often preferable to the compression of the main artery (facial artery). In wounds about the mouth, however, exert pressure over the Facial Artery which passes over the lower jaw one inch in front of its



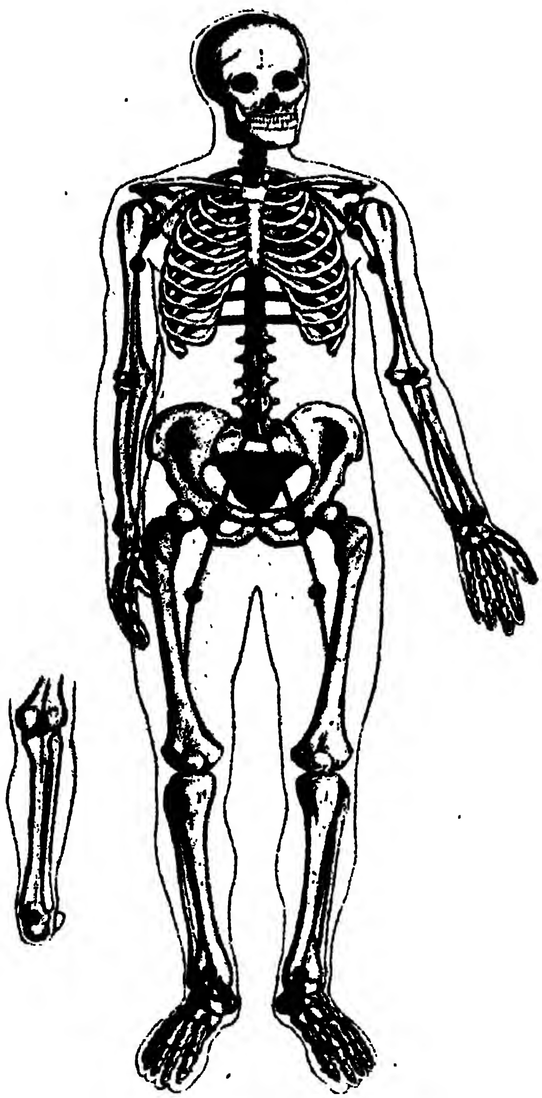
BLEEDING IN THE FOREARM AND WRIST
***Above*—The pressure point for the brachial artery, needed frequently in first-aid work *Below*—The radial and ulnar arteries.**

angle. Compress it against the jaw. It may be necessary to compress both facial arteries simultaneously.

The Coronary Arteries, branches of the facial, supplied to the upper and lower lips, run around the mouth beneath the mucous membrane one-third of an inch from the border of the lips. They are often involved in wounds of the lips, and are easily compressed by a finger in the mouth opposed to the thumb outside.

The Common Carotid Artery, running up the neck in a line leading from the inner end of the clavicle to a point midway between the mastoid process and the angle of the lower jaw, should be compressed backwards and *inwards* at a spot $1\frac{1}{2}$ inches above the sterno-clavicular joint. By directing the compressing force (the thumb) in the abovementioned direction, the artery is pushed away from the adjacent internal jugular vein and the pneumogastric (vagus) nerve, both of which are enclosed in the sheath of the artery.

The Subclavian Artery is compressible in its third portion as it crosses the upper surface of the first rib. Use both thumbs superposed, and press backwards and downwards at a spot behind the middle of the clavicle. Be careful not to press further outwards than



THE BODY'S PRESSURE POINTS
To check severe bleeding, pressure should be applied at the points shown as black dots, the point chosen being the one nearest the wound in the direction towards the heart.

this spot, and press *backwards* as well as downwards. Have the patient in a sitting position with the head turned towards the injured artery. The shoulder must be depressed, especially in stout people, and the clothing loosened.

The Axillary Artery is compressed by raising the arm and pressing outwards and backwards against the humerus at the junction of the outer with the middle third of the armpit, using the four fingers and keeping the thumb outside the limb.

The Brachial Artery requires compression more frequently than all the rest put together, this being due to the numerous accidents happening to the upper limb. It runs just under the skin, and is easily compressed. Press with the four fingers (the pulps) as in the case of the axillary artery along the inner border of the biceps muscle in the middle of the extended arm, the pressure being outwards and backwards against the humerus.

The Radial and Ulnar Arteries are compressible above the wrist (outer and inner borders) one inch above it on each side, the pressure (by each thumb) being directly backwards.

The Femoral Artery.—The thigh being abducted and rotated outwards, a line drawn from a point midway between the symphysis pubis and the anterior superior iliac spine to the most prominent part of the internal condyle of the femur will, in the upper two-thirds of its course indicate the position of the artery. To compress it, apply the two superposed thumbs at the middle of the groin midway between the anterior superior iliac spine and the symphysis pubis (see diagram), and press directly downwards at right angles to the surface. Lower down the thigh, where it becomes the Superficial Femoral Artery, pressure directed outwards and backwards at a point four fingers' breadth below the groin-fold will control the bleeding, the knee being flexed and the thigh rotated outwards.

The Popliteal Artery, the continuation of the superficial femoral artery, runs along the middle of the popliteal space behind the knee-joint. Digital compression is here unsuccessful; flexion of the knee-joint is quite satisfactory. Place a firm pad, as large as a tennis ball, in the hollow of the knee and tie the leg to the thigh so as to procure acute flexion of the joint.

The Posterior Tibial Artery, one of the branches into which the popliteal artery divides, can be compressed at a point a thumb's breadth from the internal malleolus, *i.e.* a little internal to the middle of the hollow between the heel and the inner ankle.

The Anterior Tibial Artery, the other branch of the popliteal artery, is best compressed in front of the ankle midway between the two malleoli. Press backwards.

The Dorsalis Pedis Artery, the continuation of the anterior tibial, runs in a line from the front of the ankle (midpoint) to the first interosseous space. Compression directly backwards along the line will control hæmorrhage.

We have already alluded to FORCIBLE FLEXION as a control for bleeding in connection with the popliteal artery. This can be employed also with advantage at the bend of the elbow.

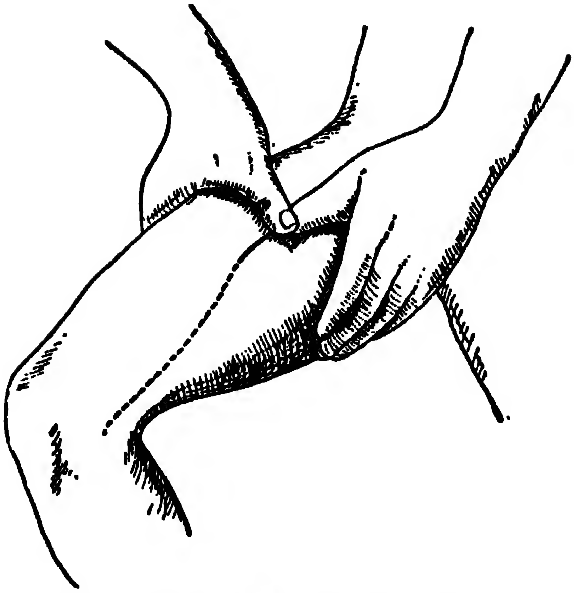
Tourniquets. The term tourniquet is applied "to any means by which pressure can be put upon a vessel and mechanically maintained" (Pye). Three kinds may be used, viz., Improvised, Screw, and Elastic Tourniquets.

The IMPROVISED TOURNIQUET is an improvement of the old method of arresting hæmorrhage by tying a bandage between the wound and the heart so as to impede the circulation. The inconvenience of that proceeding is the stoppage of not only the circulation through the artery, but also that through the veins, which latter is to be avoided, if possible. This is accomplished by the improvised tourniquet or garrot, in which a pad made of a pebble, piece of wood or cork, previously wrapped up in a handkerchief, is applied over the artery by a triangular bandage or cravat. This cravat is loosely knotted around the limb, the knot being outside, away from the artery and then tightened by the insertion of a stick, ruler, or umbrella under the knot and finally twisting it round and round. Great force is thus developed ; but only sufficient pressure must be exerted to occlude the artery and stop the bleeding. Care should be taken that the skin where the twisting is effected be not pinched.

It is hardly necessary to remind the reader that, in urgent cases, a tourniquet should be applied over the clothing, no

AN IMPROVISED TOURNIQUET—I.
A stone rolled in a handkerchief and applied over the clothing as an emergency measure.

AN IMPROVISED TOURNIQUET—II.
A ruler inserted in a knotted handkerchief and twisted to increase the pressure of the stone on the pressure point.



THE SUPERFICIAL FEMORAL ARTERY
The pressure is applied lower down than for the femoral artery, the knee being bent and the thigh rotated outwards.

time being wasted in the removal of a garment.

The Screw Tourniquet, the oldest of which is Petit's Tourniquet, is still used. To apply this type, fasten the strap around the limb just tightly enough to prevent the instrument (or the small pad of lint under the large pad of the tourniquet on the artery) from shifting. Before buckling the strap, unscrew the tourniquet to its full extent. When pressure is made, turn the screw rapidly, watching that the pad over the artery remains stationary. Tighten the tourniquet only just sufficiently to control the hæmorrhage. The inconvenience of Petit's instrument is that its application is painful and that, consequently, it cannot be endured for long. It also stops the venous circulation.

Skey's Tourniquet is free from these inconveniences. It is most suitable for the vessels of the thigh.

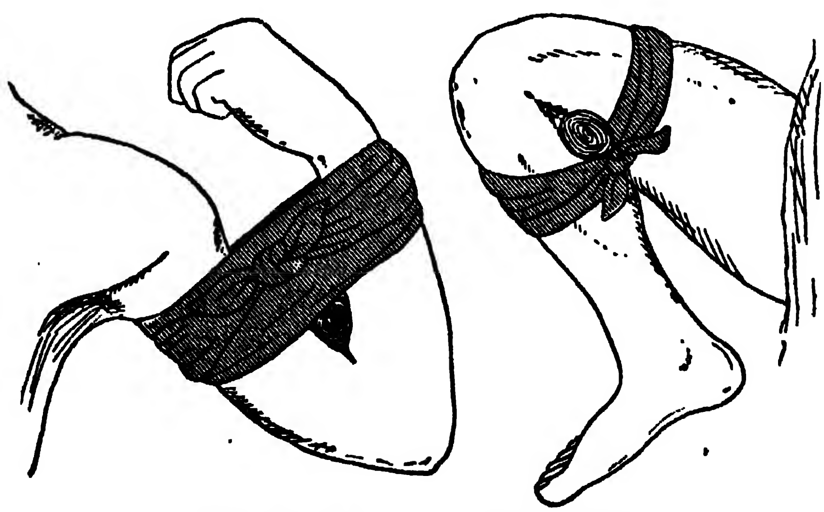
The Elastic Tourniquet, a good form of which is Foulis' Tourniquet, consists of a cylindrical disc of wood, through a hole in the centre of which is passed an elastic tube ; a slot is provided in the circumference of the disc. A turn of a wide roller bandage is passed around the limb, the disc is carefully placed over the artery. Now carry the elastic tube, previously well stretched, around the limb, and, finally, fix its ends in the slot.

In the application of the above-named tourniquets, make the pressure very gradually and do not forget to place under the pad over the artery another pad of lint or gauze. The use of such appliances is not without danger, and great care and skill must always be exercised.

INTERNAL OR CONCEALED HÆMORRHAGE

Internal hæmorrhage may follow injuries such as blows, crushes, falls from scaffoldings, stabs, which result in laceration or bruising of internal organs. Disease may also cause a rupture of a blood-vessel in an organ.

The blood effused may collect in one of the cavities of the body—abdomen, thorax, cranium, or it may find an outlet in one of the natural orifices—mouth, urethra, etc., or escape through an artificial opening. When the blood is being poured into a closed cavity, the signs previously enumerated on



COMPRESSION BY FORCIBLE FLEXION
A firm pad, as large as a tennis ball, is placed in the angle of joint, and the limb is tied over it to compress the artery and arrest hæmorrhage.

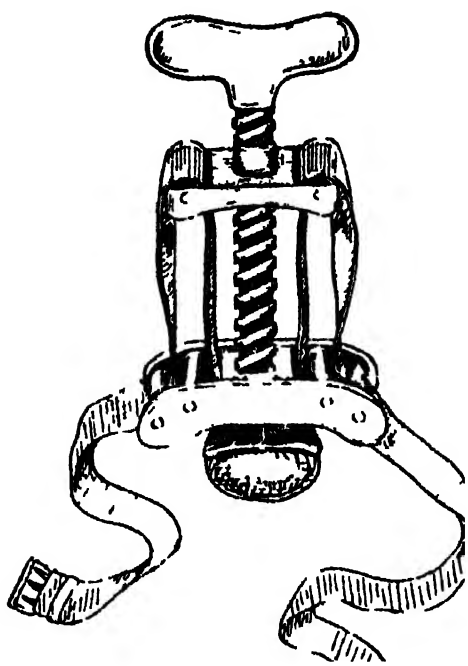
page 1115 show themselves—great and sudden pallor of the skin, coldness of the surface, faintness, restlessness, sighing, yawning, disturbances of vision, dilatation of the pupil, and, most striking of all, the hæmorrhagic pulse (frequency of beats, compressibility and collapse between the beats). In such a crisis, keep the patient recumbent with the head low, cover him with hot blankets and apply hot water bottles to the feet, but give no stimulants for fear of increasing the hæmorrhage.

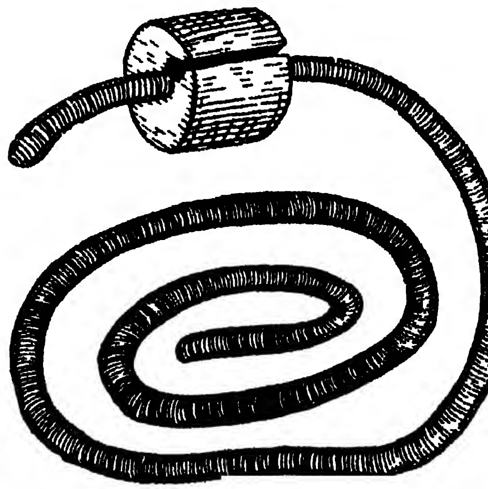
When blood escapes through a natural orifice, it may be spat with or without cough, or vomited, or it may find an exit through the nose.

Blood-Spitting.

The source of blood-spitting may be the mucous membrane of the mouth (gums, the socket of an extracted tooth). In this case make the patient rinse out the mouth with very hot water; if the bleeding does not cease, add to the tumblerful of hot water, a teaspoonful of powdered alum If the bleeding can be seen to proceed from a tooth-socket, plug the cavity tightly with clean cotton wool, leaving a surplus of wool outside the plugged part and close the mouth by means of a bandage under the chin and tied on the top of the head.

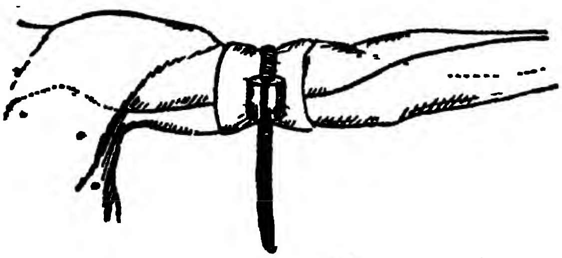
If the blood proceeds from the lungs (hæmoptysis) it will be bright red and frothy, and will be *coughed up* in mouthfuls It means either lung disease (consumption), heart disease or laceration of the lungs from fractured ribs. The First-Aider must summon the doctor without delay, keep the sufferer *on his side* with the upper part of the body raised, maintain the utmost quietude, allow no talking, keep the room cool by opening the windows, and give small pieces of ice to suck. Loosen the collar, and lay





TWO TYPES OF TOURNIQUET

Above **Petit's screw tourniquet.** ***Below:*** **Foulis' tourniquet—a slotted wooden disc fixed to an elastic tube.**



ELASTIC TOURNIQUET APPLIED

The disc is placed over a lint pad on the artery, and the elastic, well stretched, is fixed in the slot

an ice-bag on the chest, a thin layer of flannel intervening. If faintness be complained of, give *no stimulants*, keep the head low and the feet warm. In these cases, *reassure the patient*, who is naturally demoralised by his misfortune and frequently very frightened.

If the blood be vomited (hæmatemesis), the common causes of this form must be borne

A TREATMENT FOR NOSE-BLEEDING

In a severe case ice-bags are applied to the nape of the neck and the bridge of the nose. The patient should sit with the head back, arms raised, mouth open, and collar loosened.

in mind. These are: (1) Local disease (gastric or duodenal ulcer, cancer of the stomach, or corrosive poisoning); (2) Congestion (cirrhosis of the liver (gin-drinker's liver), enlarged spleen). Remember that gastric ulcer is most common in young women; duodenal ulcer in middle age and in old people, and cirrhosis in middle age and in drunkards. In duodenal ulcer bleeding by the bowel is more common than vomiting. In ulcer of the stomach, the blood may be bright-red; in cirrhosis it is dark and often clotted, and in cancer of the stomach, "coffee-ground" in appearance.

Vomiting of Blood.

The First-Aider must in these cases display a "masterly inactivity" while hastening the advent of the doctor. Keep the patient quiet on his side, give no food or alcohol, and no ice to suck. An ice-bag may be placed on the pit of the stomach.

Nose-bleeding.

The cause of nose-bleeding may be injury or disease. In children in good health and in young adults of a stout habit, nose-bleeding is frequent without any discoverable cause. It should not in these young persons be interfered with, its cessation being usually spontaneous. Nose-bleeding sometimes marks the onset of an infectious fever, more especially typhoid. It is very common in stout plethoric adults, in thickening of the arteries with a high blood-pressure, in cirrhosis of the liver, and in chronic disease of the kidneys. In one form of valvular disease of the heart largely predominant in girls (mitral obstruction), it is fairly frequent. In children, who are very apt to introduce foreign bodies into the nostrils, such a body whose introduction has been forgotten will sometimes provoke suppuration, which is occasionally complicated by nose-bleeding. This cause must never be lost sight of in children.

Keep the patient sitting up with the head thrown back, and instruct him to breathe through the opened mouth. Make him don a bib in order to avoid the soiling of his clothes. Forbid blowing of the nose, and loosen all constrictive apparel (stays, collars, belts). In most instances the bleeding will then cease. If it persists, keep both arms raised above the head and apply an ice-bag to the nape of the neck and another to the bridge of the nose.

BURNS, SCALDS AND ELECTRIC SHOCKS

BURNS are caused by dry heat (fire or contact with a heated iron), by a rail or wire charged with high tension electricity, by lightning, by a corrosive acid (oil of vitriol, etc.), or alkali (ammonia, caustic soda, quicklime), and finally by the excessive friction of a swiftly revolving wheel (brush burn).

Burns and Scalds.

Scalds are the result of the application of moist heat (boiling water, hot tar, or oil).

The effect of burns and scalds may vary from a slight reddening of the skin and the formation of blisters, to a charring and destruction of the deep tissues (fatty tissues, muscles, etc.). It must not be forgotten that, in addition to the local damage, there is, *especially when an extensive area is involved*, profound shock, and physical depression. In these extensive burns, a fatal result is most commonly to be apprehended within the first twenty-four hours after the accident. An additional danger in these cases is the supervention of ASPHYXIA or of poisoning by carbonic oxide. The prompt arrival of the doctor is highly desirable. In the meantime, if symptoms of asphyxia be observed, artificial respiration should be resorted to and persevered in; send for oxygen to the nearest pharmacist's, and administer it without interrupting the artificial respiration. In the treatment of SHOCK, mostly to be dreaded in burns involving the neck, chest, head, abdomen, and particularly the genitals and the perineum (the fork), cover the patient with warmed blankets, apply hot water bags to the feet, the arm-pits and over the heart, carefully testing them previously by application to your own cheek. Cover the bags with flannel. Shock is usually very marked in children and old people.

A diffusible stimulant such as a teaspoonful of sal volatile in half a tumblerful of cold water may be given in sips, and hot sugared tea or coffee administered.

Having done your utmost to combat these

A DRESSING FOR A BURN
Boric or eucalyptus ointment is applied on strips of lint and held in place with cotton wool and a roller bandage.

most urgent complications, carefully remove the clothing from a small area at a time, using scissors where necessary. Where the clothing adheres to the charred flesh, soak it off with some warm boiled water in which bicarbonate of soda (not washing soda) has been dissolved (a dessert-spoonful to the pint). When the burns have been caused by a corrosive acid, bathe the damaged parts first with warm boiled water, and then with the soda solution. If the cause be a corrosive alkali, use instead of the soda solution a weak solution of vinegar or lemon juice (vinegar one part, water two parts). If any lime adheres to the part, remove it with moistened cotton wool before applying the diluted acid (vinegar).

It is better to leave the opening of the blisters (if any) to the doctor, but the sooner the burnt parts are protected from the air, contaminated as it is with floating germs, the better. Remember that, after the shock has been remedied, the greatest risk is the *introduction of germs* into the wounds.

The choice of dressings lies between two —the oily mild antiseptic and the active antiseptic.

Dressings.

(1) The oily mild antiseptic may be boric or eucalyptus ointment, and should be spread on narrow strips of lint, or, preferably, butter-muslin, applied and covered with clean absorbent wool and bandaged on by means of a roller bandage.

(2) The best active antiseptic is picric acid (1 part in 100 of water). Soak strips of boiled sterilised lint in the solution and apply ; or picric acid gauze (procurable at the pharmacist's) can, after moistening with warm boiled water, be used in strips, covered with a thin layer of absorbent cotton wool and a roller bandage.

If there is choice between the oily and the actively antiseptic dressings, preference should be given to the latter. After oily dressings the parts have to be cleaned before applying another dressing, whereas this painful process is avoided when picric acid is used. The picric acid dressing promotes healing, especially in superficial burns ; it is also a more efficient antiseptic than the oily ointments above mentioned.

A new method for the treatment of extensive burns consists of the application of a solution of tannic acid. The danger period in the course of a burn commences between six and twenty-four hours after the injury, owing to the onset of an acute blood-poisoning. Excessive heat causes the disintegration of the protein of the human tissues, and leads to the formation of a poison which is rapidly absorbed into the blood stream. It is this blood-poisoning which is largely responsible for the high death-rate in burns.

The principle of the new method of treatment is to prevent the absorption of the poison into the circulation, by inducing coagulation of the injured tissue and thus rendering the poison non-soluble. For this purpose a freshly prepared watery solution of tannic acid (2.5 per cent.) is sprayed on the damaged area (previously cleansed with ether), which is then dried through the medium of electric light bulbs in a bed-cage. Alternate spraying and drying are carried out at hourly intervals until the whole of the burnt part is covered by a thin layer of coagulated tissue.

It is claimed that the tannic acid method of treatment prevents the dangerous blood-poisoning in many cases and invariably lessens its severity should it develop. Pain and discomfort are rapidly relieved. The coagulum, acting as a splint, ensures the best conditions for the healing processes which progress beneath it, and leads to a minimum of scar formation and subsequent deformity.

To EXTINGUISH THE FLAMES if the clothing is on fire, make the sufferer lie down out of a draught ; cause him to roll over and over while you take off your own coat, or procure a rug, blanket, or tablecloth. Stand on one side of the patient near the head, fix with your foot a corner of the rug or blanket and let it fall from the head to the toes of the patient so as to drive the flames away from the face as you smother them.

Electric shocks may be caused by a stroke of lightning, or a current produced artificially (telegraph, telephone, electric rails, etc.). The disturbance occasioned by telegraph and telephone wires, conducting as they do only low tension currents, will probably be limited to slight shock. Contact with wires conducting high tension currents, and more especially the alternating current, render electric lighting and motor wires especially dangerous.

Electric Shocks.

A current of 100 volts is dangerous ; the limit of tolerance for an average adult man is 300 volts. A dynamo may generate a current of 10,000 volts. The current for feeding arc lamps is generally 2400 volts, and that for domestic lighting has a voltage of 250. Contact with live wires, *i.e.* wires giving passage to a current, is very dangerous when the insulating material is accidentally worn away.

A person touching such a naked live wire conducting a current of high voltage would be unable to let go, and would be convulsed ; he may be unconscious or in a condition of suspended animation. He may even be dead. The part of the body making contact, with the adjacent clothing, may be burnt or charred.

First send for a doctor, or, rather, doctors, for one or more may be from home. If the patient still maintains contact with the wire, that contact must be broken in such a way as not to endanger the First-Aider. Switch off the current. Avail yourself of the insulating properties of rubber ; cover your hands with rubber gloves or a fold of a rubber apron or coat. Wear rubber overshoes and then drag away the patient's body. If this be not feasible, use a *dry* stick to knock away the wire, draw away the patient by his clothing, if dry, with yourself standing on some poor conductor (dry wood, cement) and short circuit the current with a bar of metal or wire previously grounded, *dropping* the bar on the cable.

Even if you can detect no breathing, and the patient appears to be pulseless, he may still be alive. Send for some oxygen, meanwhile persevering with artificial respiration. There seems to be a consensus of opinion in favour of the Schafer (prone position) method, as it is of easy accomplishment, it requires only one person for its performance, it effects a more thorough interchange of gases in the lungs, and, moreover, the tongue remains forward. Besides, the Silvester method would often be impracticable, owing to the arm muscles being spasmodically contracted.

When breathing has been restarted, remove the patient into the fresh air, pull his trousers and drawers up to his knees, pull forward the tongue, and keep it forwards by grasping it in a handkerchief between your finger and thumb. Then, after clearing the mouth and nostrils of mucus, change to the Silvester method should the spasm of the muscles have subsided. Get an assistant to rub the limbs *towards* the heart, and apply local heat to the feet and heart-region to encourage the circulation. Utilise an occasional inspiration to apply smelling salts to the nostrils, and when consciousness returns, give in repeated sips some sal volatile in cold water (one teaspoonful in a tumberful of water). Administer oxygen to help the artificial respiration.

WOUNDS

WOUNDS are breaches of the surface of the body with more or less damage to the tissues beneath the skin, and with or without implication of an underlying organ. An exception to this definition must be made in favour of contusions, in which external violence causes subcutaneous damage without severing the skin. Contusions will be discussed before coming to the subject of wounds as above defined.

Contusions.

In this injury, the cellular tissue beneath the unbroken skin is lacerated, without necessarily involving muscles, tendons, nerves, or bones. The signs are pain, bruising and discoloration of the skin

(ecchymosis) and swelling. The discoloration is caused by the pouring out (extravasation) of blood into the loose cellular tissue under the skin from the rupture of capillaries and small blood-vessels. When this blood forms a large collection in a cavity in the damaged tissue, it is called a hæmatoma. In this, the blood, at first fluid, clots at the circumference, and so forms a hard border enclosing the unclotted portion. This might be mistaken for an abscess. In a hæmatoma, however, apart from the history, the part is not hot to the touch and the collection is first fluid before solidifying. In an abscess, the part is hot to the touch, the solidity has been gradually replaced by softening, and the patient is feverish. In a hæmatoma, the blood may become absorbed; it may become organised and remain permanently as a solid swelling, or an abscess may form. It should not be forgotten that a blow on the abdomen may cause, besides a contusion, a rupture of an internal organ, such as the liver or enlarged spleen. This serious complication will be evident from the *deepening shock* as already described in the section on internal hæmorrhage. The treatment of a contusion by the First-Aider awaiting the arrival of the doctor is limited to rest of the part, and to the attempt to arrest the hæmorrhage under the skin by the application of an ice-bag or of an evaporating lotion (spirits of wine, one ounce, solution of acetate of ammonia, one ounce, cold water, six ounces). Dip a layer of lint or a handkerchief in the lotion, and having laid it on the part, let it evaporate into the air without hindrance, so as to generate cold. If a bruise be seen early, the best treatment is pressure by means of a large compress of dry cotton wool firmly bandaged, the part being, if possible, raised. In a general bruising of the body, if the patient be not faint, a warm bath is most comforting.

It is usual to classify wounds into two categories: simple and poisoned. Although the latter may be inflicted by such a weapon as a poisoned arrow or spear or a dirty knife, the cleanest simple wound may be, and is frequently, converted into the poisoned variety by contact with the soil, foul clothing, or contaminated (that is, uncleansed) fingers. Remember that the skin is always contaminated by germs; the fingers of the cleanest First-Aider should never touch even a foul wound before they are sterilised by, first, a thorough scrubbing with a clean nail brush in hot soap and water; secondly, an equally thorough drying on a clean towel, followed by the application of a 2 per cent. solution of iodine in rectified (not methylated) spirit.

Simple wounds are classified into:

(1) Clean-cut or incised wounds, caused by a knife or some sharp-edged instrument. Here the edges are clean-cut and the hæmorrhage is generally abundant.

(2) Bruised or contused wounds. Here we have the contusion already described plus a severed skin, caused by some blunt instrument. The bleeding is, in this variety, scanty or absent.

(3) Punctured wounds (stabs), caused by a pointed weapon (dagger, hat pin). There may be abundant hæmorrhage and important internal organs may be involved.

[*From " First-Aid at Factories and Workshops," Copyright, H.M. Stationery Office*

TREATING A SMALL CUT

Applying tincture of iodine by means of a sterile cotton wool swab on the end of a stick, which is thrown away after use.

Subsequent septic trouble may be encountered from the frequent introduction of germs.

(4) Torn or lacerated wounds, caused by bites, contact with machinery in action, hooks, etc. Here the edges of the wound are ragged and the bleeding is scanty. In wounds caused by projectiles (bullets), the punctured and the lacerated varieties are combined; there may be extensive internal injuries of a perforative character.

THE FIRST-AID TREATMENT OF WOUNDS

The indications are :—

1. TO ARREST THE HÆMORRHAGE.—This subject has been fully discussed in the chapter dealing with hæmorrhage. It only remains to add that the quick healing (cicatrisation) of a wound depends largely upon the complete cessation of bleeding.

2. TO STERILISE THE WOUND, AND TO KEEP IT STERILISED.—On no account should ordinary water drawn from a tap be used to wash the wound. Do not use boiling water cooled by the addition of cold tap water. Obey the directions already given for the sterilisation of the First-Aider's hands. The solution of iodine is by far the best sterilising agent; where it is not available, however, follow the scrubbing in hot soap and water by immersion for a few minutes in a 1 in 2000 solution of corrosive sublimate or in carbolic lotion (1 in 40). For the cleansing of the wound, use clean absorbent wool dipped in carbolic lotion (1 in 40) or in the sublimate solution. Squeeze the antiseptic solution over the wound; do not scrub its surface. If neither the carbolic lotion nor the sublimate solution be at hand, substitute Condy's Fluid (two teaspoonfuls in a tumblerful of cold, previously boiled water) or even whisky diluted with an equal quantity of the sterilised water.

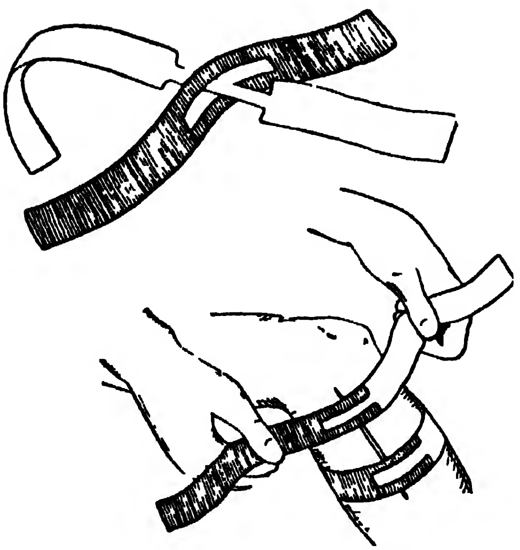
Having cleansed the wound and the neighbouring skin, cover it with dry sterilised gauze, if at hand, or with a pledget of absorbent wool moistened with carbolic lotion (1 in 40). This prevents the access of germs till the doctor arrives. Should the doctor's arrival be long delayed, a widely gaping wound may have its edges approximated as depicted on page 1130, the adhesive strapping being applied in strips separated by intervals.

STERILISING A WOUND

The antiseptic lotion (1 part carbolic to 40 parts boiled water) is squeezed over the wound from a swab of clean absorbent wool.

3. TO KEEP THE PART AT REST.—Place an arm or a leg on a pillow, or sling the arm. Keep the patient lying down.

4. TO COMBAT SHOCK.—This complication has previously been discussed. The directions already given will apply to all varieties of wounds; a few remarks must, however, be made on some poisoned wounds.



STRAPPING FOR A GAPING WOUND
The method of applying adhesive strapping to close a gaping wound when the doctor's arrival is delayed.

Stings of Insects. The stings of insects (wasps, bees, flies, mosquitoes, midges, spiders) although very painful, are not dangerous, unless the stings are very numerous or in a dangerous region (tongue, pharynx), where serious swelling may supervene. Such a complication as erysipelas may also occur after wasp or bee stings. The treatment consists of the application of an alkali (strong solution of washing soda, or sal volatile), except in the case of wasp stings, for these insects inject an alkaline venom, so that the old practice of immediately rubbing the injured part with onion (acid in reaction) is scientifically justified. The application of oil of peppermint relieves. Bees leave their barbed sting in the wound; this should be extracted with forceps. Wasps do not lose their stings. Where collapse follows bee or wasp stings, administer sal volatile or whisky (both diluted).

Snake-bites. For snake-bites, apply a ligature between the bitten part and the heart. For this purpose, use a handkerchief or a narrow-fold triangular bandage, and, in the case of the limbs, tie the ligature on the upper arm or the thigh. Give a strong dose of whisky. Make a crucial incision, across the puncture, pack it with crystals of permanganate of potassium, or wash it out with Condy's Fluid slightly diluted (1 in 2 of water).

Snake-bites are rare events in this country, the only venomous snake likely to be encountered being the adder. If bitten even by an adder not much harm is done, the poison not being very virulent excepting to children or weakly adults. The effects in such persons (great prostration, weak pulse, clammy perspiration, dilatation of the pupils, delirium ending in coma) are postponed till an hour or so after the bite. In such a crisis, give stimulants freely, and, should the breathing be arrested, practise artificial respiration.

Bites by Rabid Dogs. In the case of a bite by a rabid dog, tie a ligature or apply a tourniquet between the wound and the heart (if the bite be on the leg, the tourniquet or ligature must be on the thigh; if on the forearm or hand, on the upper arm). Get the patient to suck the wound, spitting out the blood. Wash the wound with warm water to encourage the bleeding, and cauterise it with cotton-wool applied to a knitting needle-point and dipped in pure carbolic acid. Identify the offending dog, have it arrested and shut up for examination by a veterinary surgeon. The doctor, who should always be summoned at once, will probably see that, in a suspicious case, the Pasteur treatment is utilised.

A word must be written on the subject of wounds contaminated by garden or field soil, stable refuse, and dust or soil of any kind. Patients whose wounds are thus contaminated are liable to suffer from LOCK-JAW (tetanus), for the bacillus of tetanus is almost constantly present in such garbage. Agricultural labourers and negroes who till the ground are specially liable to this disease. Horses are also very susceptible to tetanus, the bacilli of which are frequently present in their dejections (droppings). Hence

stablemen are exposed to the disease. A lacerated or punctured wound, especially of the hand or sole of the foot, is, in these persons, dangerous. Thus it is that serious street accidents, especially those due to tramcars and motor vehicles, are prone to bring tetanus in their train. Gunshot wounds due to blank cartridges are sometimes followed by tetanus, which is communicated by the wad, made of coarse horsehair felt, likely to contain tetanus spores. This is another reason why wounds should be thoroughly disinfected by First-Aiders, and why the responsibility in such contingencies should be promptly transferred to the doctor, who, in these tetanus-threatened cases, will doubtless have a protective injection of anti-tetanus serum made.

Wounds of the Abdomen.

If these wounds penetrate the abdominal cavity, an organ contained therein may be involved, and some of the contents of the cavity may be extruded. There is generally profound shock, and sometimes vomiting and pain. Where no organ is extruded, disinfect the wound, and apply a dry sterile dressing. Where a coil of intestine or the stomach is extruded, wash the prolapsed structure with warm sterile salt solution (one teaspoonful of salt to a pint of water that has been boiled and allowed to cool sufficiently), and cover with a sterile dressing moistened occasionally with the same warm salt solution and (over the dressing) a layer of cotton wool. *Give nothing by the mouth.* Beyond the measures calculated to combat shock, nothing should be done until the doctor's arrival excepting the maintenance of bodily heat and quietness.

Gunshot Wounds.

With gunshot wounds, *i.e.* wounds from a rifle, revolver, or shotgun, in civil life the bullet is generally made of soft lead. Penetrating through the clothing, the missile often carries with it fragments of cloth, or of an undergarment – all sources of infection. It has been remarked how frequently a bullet will penetrate past arteries and nerves without injuring them. For this reason primary and serious hæmorrhage is comparatively rare.

Seek the wound of exit. Swab the entrance and exit wounds with tincture of iodine, and apply a sterile dressing, but *do not probe either wound.* The special danger of a wound made by a blank cartridge has already been pointed out. This same danger from an infected wad is shared by wounds from toy pistols.

SPRAINS, DISLOCATIONS AND FRACTURES

SPRAINS

A SPRAIN is an injury of ligaments, joint-capsules, muscles, tendons or nerves caused by an abnormal movement of a joint (wrench, twist). It can easily be seen that the extent of the injury may range from a slight stretching of a ligament with no swelling to a rupture of several ligaments and of muscles in the neighbourhood of the implicated joint. Sprains may be divided into five categories :—

(1) Sprains with fractures. Since the introduction into daily practice of the X-rays, injuries formerly diagnosed as sprains are now frequently found to be complicated by a fracture, this being often the case when the wrist or the ankle is concerned. It is fast becoming the practice to have all sprains submitted to X-ray examination.

(2) Sprains with effusion into joints. Here the injury has led to an attack of inflammation of the investing membrane (synovial membrane) of the joint, *i.e.* synovitis. The joint, distended by fluid, is very swollen. In these cases, subsequent formation of adhesions (fibrous bands) are apt to limit movements and so leave a stiff joint.

(3) Sprains with marked swelling. These injuries are associated with rupture of muscular fibres and of blood-vessels. There is present great swelling of the joint and discoloration, owing to effused blood.

(4) Sprains with displacement of tendons, occurring usually about the shoulder, ankle or wrist.

(5) Sprains with injury to nerves. The nerve may be simply bruised, or it may be ruptured. When only stretched, it will

Courtesy] [" X-ray Atlas," McKendrick & Whittaker (E. & S. Livingstone)

A TYPICAL DISLOCATION

An X-ray photograph of a dislocation of a joint of the little finger, seen from the back.

inflame and become exquisitely tender. Rupture of a nerve is rare, as it will, from its natural elasticity, bear a good deal of stretching without giving way. The necessity of seeking signs of nerve-damage in all severe sprains is essential. Where numbness persists for twelve hours the existence of this complication is highly probable.

Place the joint in a position of *complete rest*. This can be best attained by the application of a well-padded splint. In the upper extremity, apply the splint to the inside of the limb and support the arm in a large arm-sling. In the lower limb, apply the splint to the back of the leg and elevate the leg on a pillow. Then apply to the injured joint hot compresses (as hot as can be borne comfortably) or a hot bran poultice. This is more soothing and safer than an ice-bag, which may produce sloughing (mortification) of the skin.

First-aid Treatment.

Sprains without swelling are best treated by immediate massage; but this is best left to the doctor.

DISLOCATIONS

A dislocation is the partial or complete separation of one or more of the bony structures of a joint from the normal situation.

The signs are an alteration of the shape of the joint, seen by comparing it with its fellow; an alteration in the length of the limb; loss or impairment of movement in the joint; local pain.

This injury is commonest in men, rare in children. It is most frequent in the upper limb. Do not forget that a fracture may co-exist with a dislocation, and that further damage may, in such an eventuality, be caused by a rough examination.

In treatment, *refrain from attempting to reduce the dislocation.* Place the patient in an easy position *in bed.* Support the dislocated joint on a pillow and await the arrival of the doctor, to whom you may prove useful.

FRACTURES

By a fracture is meant a broken bone. The causes are divided into two classes, the predisposing and the exciting.

The predisposing causes include factors of age, sex, and abnormal conditions of the bones. The unsteadiness of gait (inco-ordination) of children between the ages of two and four years occasions frequent falls, and hence fractures are not uncommon. From four to six years of age, bendings of the bones (greenstick fractures) are frequent. Later in life, up to the age of eighteen years, injuries in the neighbourhood of joints cause separation of the growing ends of the bones (epiphyses).

Fractures are, as might be expected, most common during the active periods of life (boyhood and manhood) and in the male sex. Up to the age of four or five, they are as frequent in girls as in boys. After the age of forty-five, they are commoner in women, this being due to their marked liability to fractures of the neck of the thigh-bone (the part within the capsule of the hip-joint) and of the lower end of the radius (Colles' fracture). Aged folks, in whom the bones are normally more brittle, are liable to fractures on this account.

The abnormal conditions of the bones, which favour fractures after slight injuries, are atrophy (wasting) of bone in old age or from disuse, as in a paralysed limb or a stiff joint; general paralysis of the insane and locomotor ataxia, sufferers from which diseases of the nervous system are very liable to broken bones; an inherited tendency to spontaneous fracture; rickets; a malignant growth (sarcoma and cancer) in a bone.

The exciting causes of fracture are three, viz.: direct violence; indirect violence (as in fracture of the base of the skull from a fall from a height on the feet); muscular violence (as in a transverse fracture of the knee-cap from the sudden contraction of the muscular mass above the knee in front of the thigh).

Fractures are divided into two great classes: simple and compound fractures.

Varieties of Fracture.

In a SIMPLE FRACTURE the bone is broken in such a way that, the skin being intact, there is no communication between the seat of the break and the outside air.

In a COMPOUND FRACTURE, such a communication, direct or indirect, is present, owing to a laceration of the skin or mucous membrane covering the bone.

This nomenclature, in use for many centuries, would be improved by the substitution for simple and compound of the terms subcutaneous (under the skin) and open (open to the air with its contained germs). Accordingly these more scientific terms shall be adopted in this chapter.

Before the era of antiseptic surgery, the open nature of a fracture aggravated the situation in that it opened up the pathway to infective processes absent in the subcutaneous variety. We have now learnt that this invidious distinction has lost much of its force. A subcutaneous fracture is often a serious matter, while an open fracture may be quite an innocuous affair in which a better result may be obtained than in the fracture not in communication with the germ-laden outside air. Such is the revolution brought about by modern methods.

Certain sub-varieties of fractures are met with in practice. These are:—

(1) Incomplete fractures. The use of X-rays has taught us that the incomplete variety is commoner than was formerly believed. The greenstick fracture is met with in young children, especially in those suffering from rickets. Here the fracture involves only the convexity of the bone, the break not extending to the concave part of the circumference, which is only bent. Curved bones, *e.g.* the clavicle, are usually affected. Fissured fractures are also, often, only partial. A sub-periosteal fracture is one in which the periosteum (the membrane covering the external surface of the bone) is intact. Here there is no displacement of the fragments, and, were it not for radiography, the injury might not be noticed.

(2) An impacted fracture is so called when one fragment is driven or wedged into the other. This occurs in fracture of the neck of the thigh bone outside the joint capsule and in Colles' fracture of the lower end of the radius.

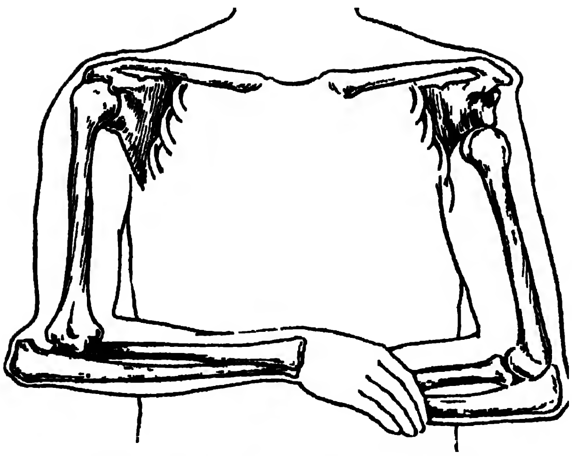
(3) A comminuted fracture is so named when the bone is broken or splintered into more than two fragments.

(4) A multiple fracture is an injury in which more than one fracture is present.

Courtesy] [*"X-ray Atlas," McKendrick & Whittaker (E. & S. Livingstone)*

A BADLY DISLOCATED JOINT

Both bones of the forearm dislocated backwards.



TWO COMMON DISLOCATIONS

A diagram showing how the elbow and shoulder joints may be dislocated—the humerus being forced out of its socket at either end.

(5) A complicated fracture is one in which important structures such as an internal organ, a main artery, or a joint are involved.

(6) The separation of an epiphysis (growing end of a bone) occurs most frequently in the femur, humerus and radius, and is seen in young people when violence is directed to the ends of the bones. This fracture passes through the shaft side of the bone-forming cartilage. The older the patient, the more likely is it to involve the shaft as well as the epiphyseal line. If the fragments be not placed in exact apposition, the growth in length of the bone may be arrested, and a short leg or arm may be left.

Extent of Injury.

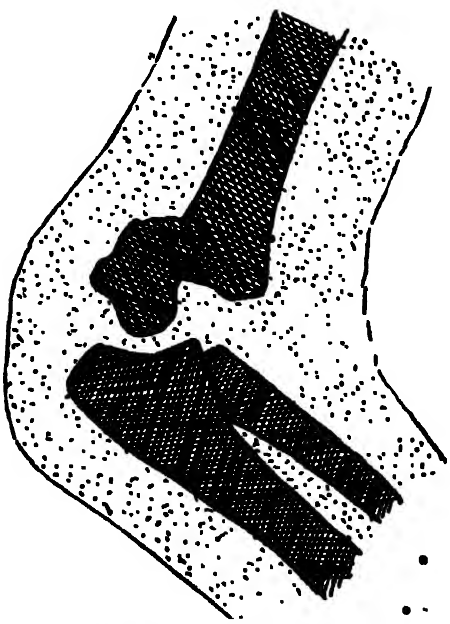
"The first time a student makes a post-mortem examination on a recent case of fracture, however simple, even if there be to outward seeming only a very slight amount of injury, he cannot fail to be astonished at the extent to which the tissues have really suffered, at the amount of bruising and disorganisation of the muscles, and at the infiltration of all the softer parts with blood. And yet, provided that such a fracture be simple, or, if compound, that septic forms of inflammation are successfully warded off, it is astonishing how quickly tissues, bruised and hurt as these are, will recover.

"In considering, then, the general line of conduct in cases of fracture, the student should think of the condition of the limb inside the skin, and appreciate the fact that it is probably much worse than appears on the surface; and, further, he should recollect that between the time of the occurrence of the fracture and its being set, careless or improper handling may do much mischief, so that it not infrequently happens that by movements on the part of the patient or of his friends, a simple fracture is converted into a compound one; or, though much more rarely, an important vessel or nerve is seriously injured." *

Union of Fractures.

The broken ends of a bone are soldered together by a process identical with that which unites the edges of a wound, the difference being that the scar tissue formed in a case of fracture is further modified by the development of bony tissue. In a fracture, the muscles and neighbouring tissues are lacerated, and a clot of blood occupies the crevices of the damaged part. After the fracture is "set," repair commences by the invasion of the blood-clot by white blood-corpuscles which eat up the clot. The periosteum

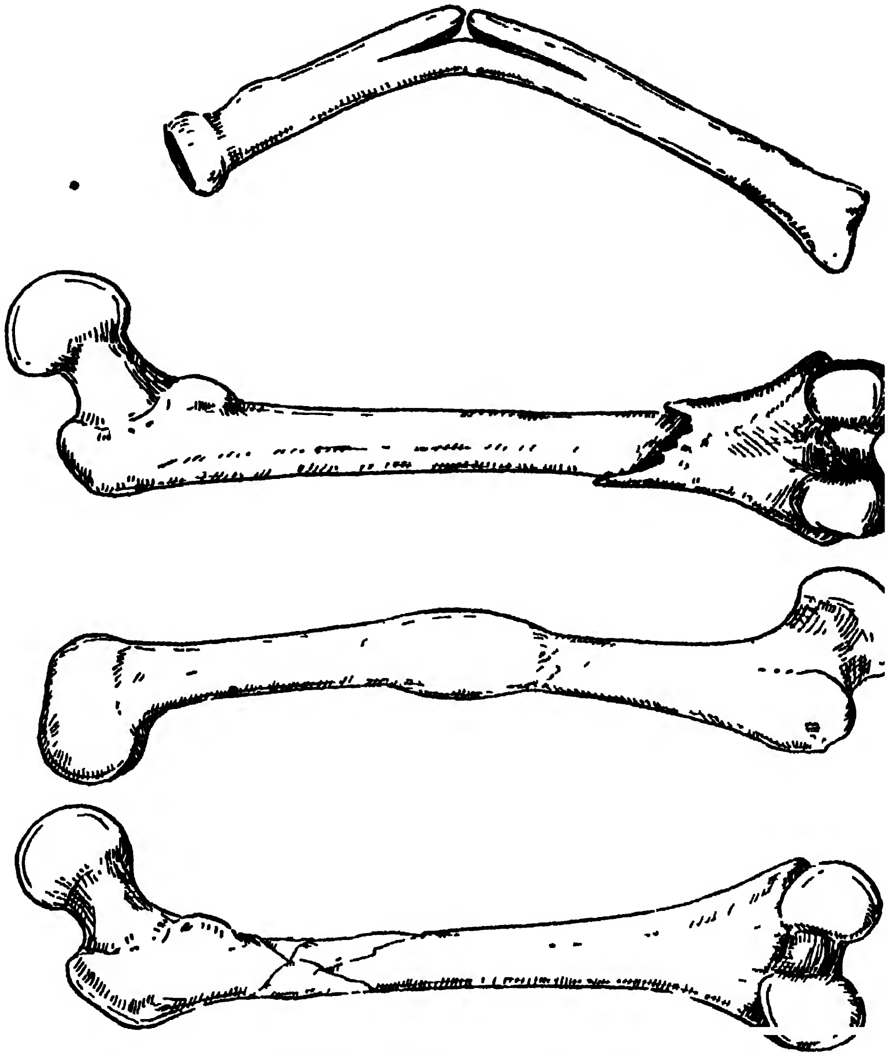
* Pye's *Surgical Handicraft.*



A FRACTURE FREQUENT IN YOUTH

A drawing from an X-ray photograph showing the epiphysis (growing end of a bone) broken from its shaft.

becomes thickened and more freely supplied with blood, and a blood-clot, separating that membrane for a short distance from the broken ends of the fragments, is soon transformed into granulation tissue (proud flesh). This tissue, with that formed in surrounding damaged structures and in the bone, shows itself as an ovoid mass binding the fragments together and known as the provisional callus or soldering. The next stage is the deposit in this callus of bony centres which develop first into soft spongy bone and finally into firm bone. The marrow in each fragment becomes transformed into granulation tissue and then into bone, which is called the internal callus. The same granulation tissue forms between the broken surfaces of the fragments. This unites with that formed in the marrow, and both become ossified together to form the permanent or definitive callus. As this becomes denser and stronger, the provisional callus diminishes and may entirely disappear together with that filling the medullary (marrow) canal. The bone may be so thoroughly restored to its primitive condition that no signs of its having been fractured may remain. This depends upon its accurate "setting" and upon subsequent rest having been maintained. In the absence of these conditions, the provisional callus persists and can be felt as a hard mass through the skin. If the ends are not in contact owing to the interposition of muscle, a non-united fracture results and a false joint may form.



COMMON TYPES OF FRACTURE
(1) Greenstick fracture—a bending of the bone occurring in young children. (2) Impacted fracture of the femur or thigh bone, one fragment being driven into the other. (3) A deposit of bone around the broken ends of a healed fracture. (4) A comminuted or splintered fracture.

The soft tissues around—muscles, tendons, etc.—undergo repair as in any other wound, but they may remain matted together so that their functions are greatly impaired. Veins and nerves may also be compressed in the scar-tissue developed. In the upper limb, the fracture is consolidated as a rule

in a month or five weeks ; in the lower limb, free walking may be impossible before eight weeks have elapsed.

First listen to the history of the accident. The sufferer often tells you that he felt or heard the bone snap, this being coincident with a sharp pain and inability to move the limb. On comparing the injured with the uninjured limb—this comparison should never be omitted—the following will be noticed :—

Signs of Fracture.

(1) Signs of a local injury (swelling, pain, bruising).

(2) Abnormal mobility in the line of the bone. (Where there is impaction, this sign is absent.) This should never be sought by a First-Aider.

(3) Absence of power, more or less complete.

(4) Shortening of the limb from overlapping of the fragments.

(5) Crepitus, or a grating sensation felt when the broken ends are moved against each other. This sign should not be sought for by the First-Aider ; only in rare instances does the doctor endeavour to elicit it. Crepitus is absent when the ends are widely separated, and in impaction.

(6) Change in the shape of the limb. There may be angular deformity, or, in the case of a fractured femur, the foot may be turned outwards. In flat bones (skull) there may be depression or elevation.

In his investigations, the First-Aider must be careful not to aggravate the situation by rough handling. A subcutaneous fracture may, especially in bones lying superficially, such as the tibia or the clavicle, be converted into an open fracture, or into a complicated fracture. As soon as the First-Aider has satisfied himself that a fracture exists, he should desist from further examination of the limb until he is prepared to render First Aid.

Examine the patient on the spot where the accident happened. In a case of open fracture, arrest the hæmorrhage, if it exists, and then disinfect the wound and apply a sterile dressing. Directions for the removal of the clothing have been given in an earlier section, see p. 1106 ; it is, however, recommended that an improvised splint be applied over the clothing, if possible.

Before moving the patient, the injured limb must be fixed in as good a position as the circumstances allow. For this purpose, the First-Aider must improvise splints out of any suitable material that may be at hand.

Splints.

These can be fashioned out of walking-sticks, umbrellas, broom handles, packing boxes, laths, newspapers folded into multiple layers, cardboard, pieces of tin or cigar-box covers. Splints must possess sufficient rigidity to immobilise the fractured bone, must be long enough to fix the joints below and above the fracture, wider than the limb, and must be padded with tow, cotton-wool, or flannel. The padding should be thick and should extend well over the edges of the splint. Measurements (length, breadth) should be taken on the sound limb, and can, with advantage, be cut out in paper as a guide to their fabrication out of the material chosen. Two or more splints are better than one. They should be firmly applied ; but they should, on no account, interfere with the circulation or cause pain. They can be fixed on by bandages (roller, triangular), strips of clothing, neckties, braces, garters, shoe-strings or napkins.

For the application of splints, the First-Aider will require the help of at least two other persons. One of these fixes the upper part of the limb (counter extension), while the other exercises gentle and steady—not jerky—traction on the lower part of the limb below the fracture. In this way, the shortening is corrected. The First-Aider then applies the previously padded splint or splints, one on each side of the limb, and while steady traction is maintained by his assistants, he fixes the splints by securing them first above and then below the fracture with narrow-fold triangular bandages, or with straps or tapes, tying the reef-knots over the splints, not over the bone.

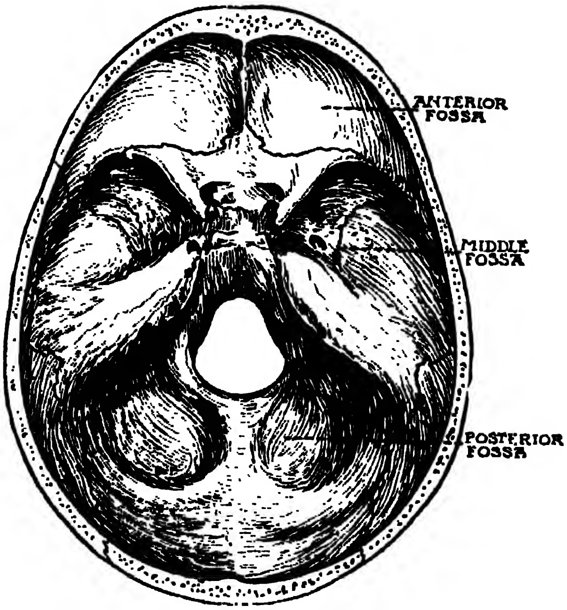
The removal of the patient should not be undertaken until the splints are applied,

[Topical

[Sport and General

TWO FIRST-AID DEMONSTRATIONS

Above—A women's ambulance team treating a roadside "casualty." *Below*—The Gorton team, winners of the Ambulance Challenge Shield, demonstrating on a man supposed to have fallen through a glass roof. The man has been treated for a severed artery in the neck, fractured ribs on the left side, and compound fracture of the right leg bone.



THE WEAK SPOTS OF THE SKULL
A view of the base of the skull from above, showing the fossæ or depressions in the bones which are very liable to injury.

particularly in fractures of the lower limb. In the transport from the ground to the vehicle, or, preferably, the stretcher, one person should be in charge of the splinted lower limb, which he should support with both hands until the patient is safely deposited in the vehicle. The splinted upper limb will, of course, be in a sling while he walks to the vehicle. Those suffering from a fractured spine or pelvis should be most carefully carried in the recumbent position but they are best left *in situ* till the doctor arrives.

Do not forget that a fracture may be accompanied by more or less shock. In this case, maintain the bodily heat and treat as directed previously.

SPECIAL FRACTURES

These are divided into fractures of the skull and face; fractures of the trunk; fractures of the upper extremity; and fractures of the lower extremity.

Skull and Face.

FISSURED FRACTURE OF THE VAULT OF THE SKULL is due to violence (blows or falls on the head) and is generally an open fracture. When the fracture is subcutaneous (simple), there may be some bruising without any other sign. When the fracture is an open one, the line of fracture may be visible as a red streak, or may be felt as an irregular ridge. If uncomplicated, no bad results will ensue. There may, however, be some concussion of the brain, with loss of consciousness.

Send immediately for the doctor and keep the patient lying down with his head raised. Should there be a scalp wound, arrest the hæmorrhage and proceed to dress the wound as directed in the chapter on wounds. Maintain the bodily heat, but administer *no alcohol*. If there be insensibility, give nothing by the mouth. If the patient has to be removed, place him on a stretcher with his head and shoulders slightly raised by pillows. Arrived at his destination, bed, a hot-water bag to the feet, and quietness constitute the First Aid treatment.

FRACTURE OF THE BASE OF THE SKULL is almost always fissured, being only occasionally depressed or punctured. It is always due to violence, either applied to the top of the head, or, directly or indirectly, to the base. The mischief may be done by the thrust of a stick or umbrella through the upper wall of the orbit or up the nose; a

BANDAGING A FRACTURED JAW
The centre of a narrow-fold triangular bandage is placed beneath the chin, one end is brought over the head and looped through the other end, which is then taken back over the chin and round the neck to tie at the side.

blow on the chin, as in a prize-fight, may drive the condyle of the lower jaw through the glenoid cavity of the temporal bone into the middle fossa of the skull; or a gunshot wound in the mouth may be the exciting cause. Then again fractures of the posterior fossa may arise from a fall on the top of the head, or from a fall from a height on the heels or buttocks. Here the shock of the vertebral column against the occipital condyles causes the fracture.

Courtesy] [" *X-ray Atlas*," McKendrick & Whittaker (E. & S. Livingstone)

A FRACTURE OF THE SKULL

A depressed fracture of the vault of the skull as seen under the X-rays.

The majority of these fractures are open, the exceptions being fractures of the posterior fossa. Fractures of the base, although very serious, are not necessarily fatal, antisepsis having greatly improved the outlook. The principal dangers are: (1) damage to the base of the brain, including the pons varolii and the medulla oblongata (bulb); (2) hæmorrhage, from the venous sinuses or from the arteries of the brain or its coverings; (3) infective meningitis, due to the laying open of the dura mater, which always darkens the outlook.

The signs are: (1) Concussion of the brain and prolonged unconsciousness. This is not invariably present.

(2) Hæmorrhage. In fracture of the anterior fossa, the bleeding will be from the nose, although some of the blood may be swallowed and then vomited. More commonly the blood finds its way to the lower eyelid and the conjunctiva. In fracture of the middle fossa, the blood may enter the nose or the mouth, but more frequently it escapes from the ears. If the bleeding from the ear be profuse, it points strongly to fracture of the middle fossa as the cause. In fracture of the posterior fossa, the hæmorrhage is generally subcutaneous around the mastoid process and spreading down the back of the neck.

(3) Discharge of cerebro-spinal fluid from one or both ears, and occasionally from the nose. The fluid, at first blood-stained, later becomes clear and watery. It often flows abundantly, soaking the pillow.

(4) Injury to the nerves of the face and organ of hearing, causing facial paralysis and some deafness. This sign is only an occasional one.

The outlook has been greatly brightened through the application of antiseptics to the ear-passage. Should cerebral complications be absent, the bones unite rapidly, and a good result is obtained. Troubles may arise later from injury of nerves or vessels by the original accident or by their inclusion in the new bone formed.

Treatment is identical with that recommended for fractures of the vault of the skull.

Of the fractures of the bones of the face only two—that of the nasal bones and that of the lower jaw—come within the purview of the First-Aider.

Fracture of the Nasal Bones is the result of direct violence (a blow from the

fist, a cricket-ball, or a stick, etc.). The fracture is generally transverse and close to the free margins of the bones; when situated at the root of the nose, and the result of great violence, it may be complicated by a fracture of the base of the skull. There is, as a rule, much bruising of the skin and considerable deformity (depression or lateral displacement). Profuse nose-bleeding is often present, and head symptoms (unconsciousness) are sometimes seen.

Keep up the patient's head and apply cold (ice-cold water, etc.), to the nose. If medical advice be unprocurable, replace the fragments of the broken bones with a clean pair of forceps introduced gently into the nostrils and then plug each nostril with a strip of sterile gauze squeezed out of carbolic oil (1 in 10 of olive oil). Owing to the free supply of blood to this region, these fractures unite rapidly, and thus any deformity left uncorrected is perpetuated. For this reason, early professional intervention is desirable.

FRACTURE OF THE LOWER JAW is generally caused by direct violence such as a fall or a blow on the chin. The fracture is almost always of the open variety owing to the laceration of the gums. The seat of the fracture is most commonly a short distance from the middle line in front, the line of fracture being vertical.

The signs are: bleeding of the gums; inability to move the jaw freely; irregularity of the line of the teeth, some of which may be loose; obvious crepitus (grating) when the jaw is gently moved on each side of the fracture.

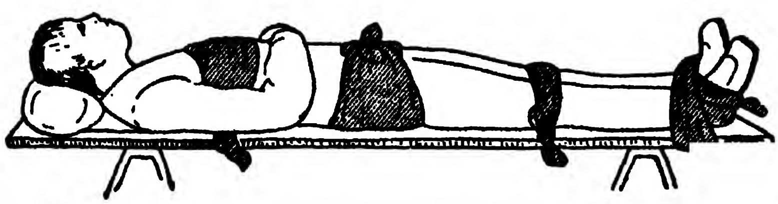
After replacing with the hand the fragments into their natural position, by gently pushing up the anterior fragment, apply a narrow-fold triangular bandage with the centre beneath the chin, carry one end over the head, cross it over the other end at the angle of the jaw, carry the long end across the chin and around the back of the neck till it meets the short end again. Knot them together as in the drawing on page 1138. The doctor will probably seek the co-operation of a skilled dentist for the definite splinting of the jaw, and will see to the thorough disinfection of the mouth—an important item of treatment.

The Spine and Trunk.

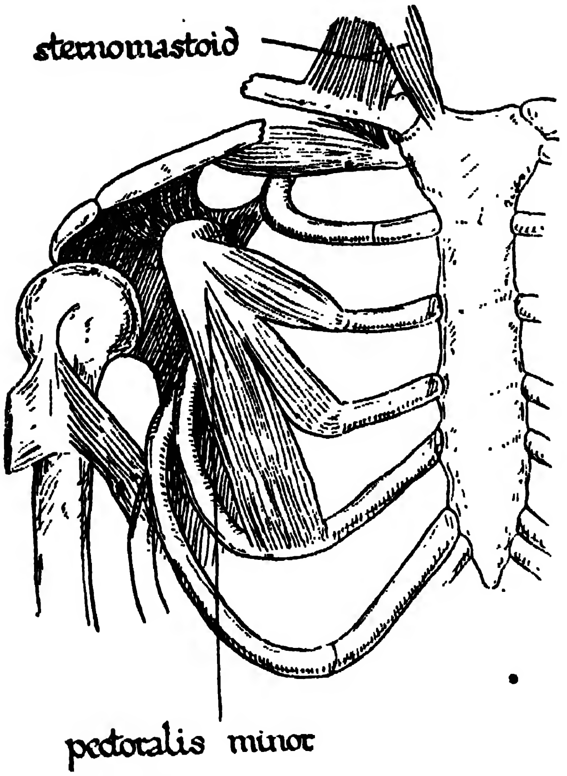
FRACTURE OF THE SPINE may be the result of direct or indirect violence. When due to direct violence—a blow with a heavy stone, a fall on a railing—the posterior parts of the vertebræ are most likely to be involved. When due to indirect violence, the fractures are generally in the lower cervical or upper dorsal regions. The indirect violence may be forcible bending of the spine as in a fall downwards with the head doubled up, or in taking a "header" in shallow water.

The signs show in most cases paralysis and loss of feeling in the parts of the body below the seat of the fracture. The higher the fracture the more extensive is the paralysis. Thus, if the fracture be just below the neck, the four limbs are powerless and without feeling; if in the middle of the back, the legs are helpless and void of sensation. In fractures high up in which the spinal cord is greatly damaged, the danger to life lies in the possible paralysis of the respiratory muscles (the diaphragm excepted) leading to a form of pneumonia called static pneumonia. Complete severance of the spinal cord above the fourth cervical vertebra is immediately fatal owing to the cutting off of the nerve supplying the diaphragm. About 70 per cent. of cases of fractured spine end fatally.

On no account should the First-Aider attempt to elicit crepitus or handle the patient with anything but the *greatest care* and *gentleness*. Do not forget that the danger lies



MOVING A CASE OF FRACTURED PELVIS
The patient is attached to a shutter by triangular bandages—broad-folded across pelvis and chest, narrow-folded across legs and ankles.



A FRACTURED CLAVICLE
Showing the most frequent seat of fracture and the muscles affected.

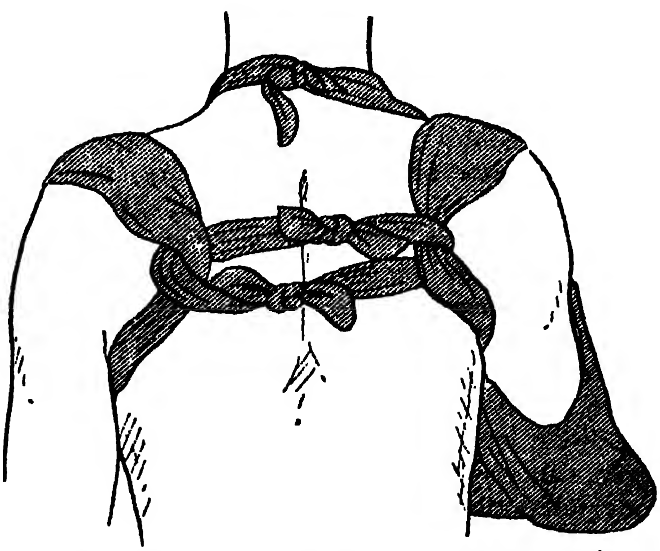
not so much in the fracture itself as in the injury to the spinal cord ; any brusque movement is likely to add to existing damage of this important structure. Therefore do not attempt to remove the sufferer before the doctor arrives. In the meanwhile, treat any symptom of shock by warm coverings, hot-water bags to the feet, and warm non-alcoholic beverages (beef-tea, coffee or tea). If, unfortunately, "force majeure" compels the removal of the patient before the doctor's advent, slide or shift the patient on to a rigid litter—*not a canvas stretcher*—keeping him on his back. From the litter lift him *most carefully* on to a *firm* bed (a fracture bed) ; and keep him lying flat with his head and shoulders low.

Remember that the application of hot-water bags unless shielded by a flannel cover to a paralysed and insensible limb is liable to lead to a serious burn unknown to the patient.

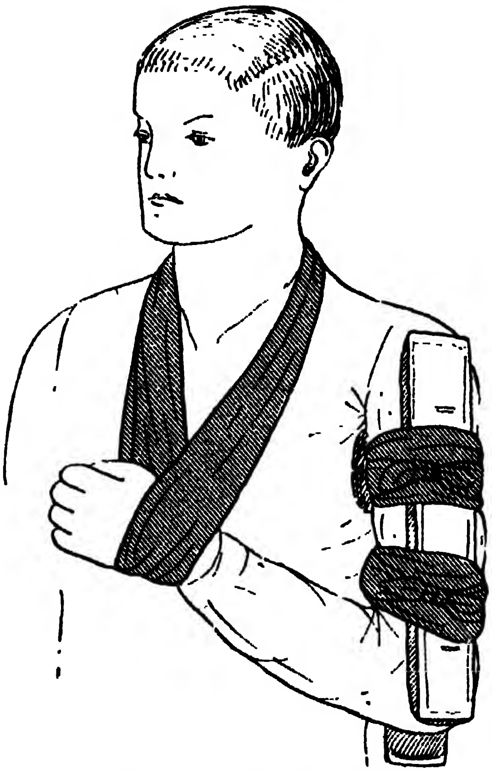
Fracture of the Ribs is caused either by direct or indirect violence. By direct violence, as in blows, the ends of the fragments are driven inwards, wounding most probably the pleura (the fibro-serous covering of the lung), lungs, liver, or diaphragm.

By indirect violence such as a crush in a crowd the ends of the ribs are brought nearer to each other, and the natural elasticity of the bone being too severely tried, it breaks generally near the angle (the most convex part), the broken ends pointing away from the internal organs. Hence, although the organs may be bruised, they are less frequently wounded by the ends of the fragments than in those cases resulting from direct violence.

Generally more than one rib is fractured, but the deformity is marked only in those instances due to direct violence where several ribs are "staved in." The ribs most frequently broken are those included between the fifth and the eighth (inclusive), these being the most prominent and the most fixed at each extremity. The lower ribs are less liable to injury owing to their greater mobility; the first and second ribs are protected by the clavicle. Elderly women and mental patients (general paralytics especially) are very frequently sufferers from broken ribs.



HOLDING THE BROKEN BONE IN PLACE
Syme's method of treating a fractured clavicle with three triangular bandages.



SETTING A BROKEN ARM—I.
The humerus, or bone of the upper arm, set with Venetian blind laths.

The signs are: a sensation by the patient of a snap, a sharp local pain, a catch in the breath, aggravated by a deep breath or cough, and crepitus felt by the palm of the hand when a deep breath is taken. If the lung be wounded, there will be spitting of blood. As a rule, the diagnosis is easy, but when a stout person has only one rib fractured, it is more difficult. When the lung is lacerated, this being more common when direct violence has caused the injury, the patient, when the laceration is extensive, suffers from pain in the side, difficulty of breathing and blood-spitting. Blood is liable to collect in the pleural cavity, this constituting hæmothorax and air from the air-cells of the lung is apt to collect in the same cavity (pneumothorax). This latter condition leads to collapse of the lung and great distress in breathing. Should the liver be injured, signs of internal hæmorrhage will be evident.

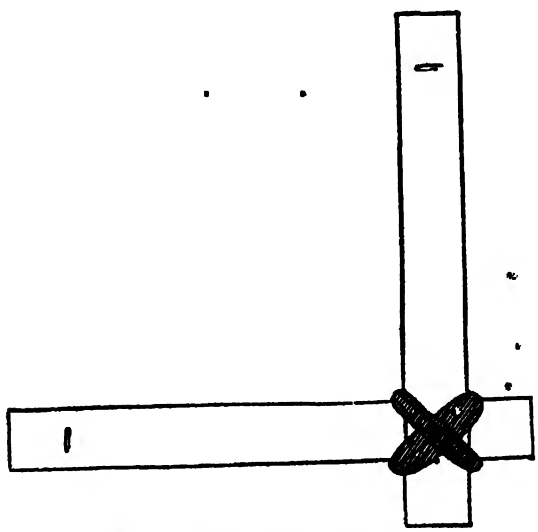
If a wide flannel bandage (four inches wide) be procurable, apply it firmly after expiration. Support the arm of the affected side in a large arm-sling. When there is blood-spitting, avoid all compression of the chest by a bandage, bind the arm to the side and keep the patient in bed with a sandbag between the shoulders. When the lower ribs are broken, avoid tight bandaging which might irritate the diaphragm and provoke hiccough.

Owing to the ceaseless movements of the ribs in breathing, the fractures, although uniting readily, are surrounded by a large amount of new bone which is likely to be permanent. For the removal of the patient, use a stretcher and deposit him *in bed* to await the doctor's visit.

Fracture of the sternum (breast bone) is almost always due to direct violence. An occasional cause is forcible flexion of the trunk; the sternal injury is generally in this case complicated by fracture of the spine.

The line of fracture is generally transverse and its site is usually opposite the upper border of the second rib, or a little lower. There may be no displacement; when the upper fragment is displaced it is backwards. This may result in great difficulty of breathing.

Treatment should be the application of a broad binder as in fractured ribs. Do not



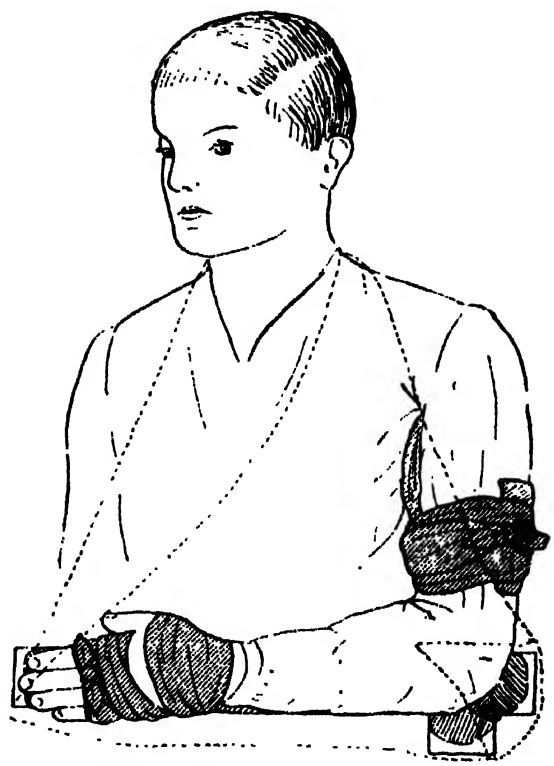
AN IMPROVISED SPLINT
Two laths, fixed together with a narrow-fold triangular bandage, useful during transport for a fracture near the elbow-joint.

forget the possibility of a fractured spine; if this be suspected, keep the patient at rest until the doctor arrives.

Fracture of the Pelvis is the result of direct violence such as a "buffer" or cart accident, a fall from scaffolding, etc. It is a very serious condition if the fracture involve the *true* pelvis, that is, its lower part. Its chief dangers are the implication of the bladder, urethra, or rectum. The portion of the urethra in the perineum, *i.e.* the membranous portion, may be torn; the bladder may be ruptured or the rectum may be punctured (usually by the jagged end of the fractured coccyx (tail-bone). A fracture of the upper portions of the pelvis (the false pelvis) is unattended by these risks.

The signs show pain in the pelvic region, especially on moving legs or on coughing. The patient is unable to stand, and there is local tenderness. If the urethra be wounded, blood is passed; if the bladder be involved, the patient urgently desires to micturate, but is unable to do so. There is almost always profound shock.

Send an urgent message for the doctor, with particulars of the emergency. If blood be passed, urge the patient to refrain from attempting to empty his bladder. Treat any shock that may be present. Apply firmly around the hips a broad flannel binder, or a couple of broad-folded triangular bandages and tie the knees together. The application of two long padded splints reaching from each armpit to beyond the feet, fixed here and there with narrow-fold triangular bandages will confer additional security. Should removal be absolutely necessary, place the patient on a shutter a little wider than his body and attach him to it by triangular bandages, one, folded broad, across the pelvis, and one across the chest, the rest, narrow-folded, across the thighs, legs and ankles, so as to prevent wobbling. Underneath the body, a thick blanket should be spread, with a pillow beneath the head. In the application of the narrow-fold bandage securing the ankles, use a figure of eight.



SETTING A BROKEN ARM—II.
The improvised (L-shaped) splint in position. The arm should be supported in a large sling.

Fracture of the Clavicle. Bones in early life are developed from cartilage, *e.g.* the long bones, including the clavicle; and from membrane, *e.g.* the flat bones of the skull. The clavicle enjoys the distinction of being, of all bones, the earliest to be ossified, *i.e.* converted from cartilage into bone. It has the further invidious distinction of being the most frequently fractured of all the bones of the body, the radius running it close. This frequency is accounted for by its exposed situation, and by its function as a buttress in keeping out the joint of the shoulder, the result being that every shock to the arm is communicated through the clavicle to the trunk. Hence, although direct violence is sometimes the cause of the break, in the majority of cases, indirect violence (force applied to the shoulder or the hand, as in a fall from a horse) is responsible for it. It is commoner in men than in women; in children it is often of the greenstick variety of incomplete fractures. The commonest

The Upper Extremity.

seat of the fracture is at the centre of the bone or somewhat external to this point, the line of fracture running somewhat obliquely from before backwards, downwards and inwards.

The signs show the supporting of the elbow with the other hand with the head bent over to the injured side in order to relax the muscles of the neck. The arm is more or less impotent. The point of the shoulder is flattened, lower than on the other arm and drawn by its weight towards the middle line. The inner fragment can be felt projecting against the skin. This deformity is explained by the displacement of the outer fragment downwards, inwards and forwards.

Complications are rarely met with in the ordinary fracture from indirect violence. In those resulting from direct violence they are more frequent. The subclavian vein or the brachial plexus of nerves, the bundle of nerves in the armpit destined for the arm, may be injured.

A SUBSTITUTE FOR A SLING
A large safety-pin, fixing the sleeve to the coat, may be used to support a broken arm when a sling is unavailable.

When women are the victims of this accident, the best treatment is to keep them on a firm mattress for three weeks with the head low and a sandbag placed between the shoulder-blades, the arm being bandaged to the side. This method reduces the risk of deformity to a minimum. For other patients, Syme's three-handkerchief method may be put into practice.

In SYME'S METHOD, take two triangular bandages folded narrow, placing one vertically over each shoulder and under the armpit. Reef-knot them behind so as to make a loose loop, and, having drawn the shoulders well back, tie the upper and lower ends of each loop together behind over a large pad placed under the knots. Now apply with the third triangular bandage a broad sling for the arm, bringing the hand up over the sound clavicle.

The period required for union is about a month, but it is necessary to keep the arm quiet in a sling for another week or two. Very marked callus formation is the rule in these fractures.

FRACTURE OF THE SCAPULA is caused by direct violence, the signs being powerlessness of the limb and crepitus on movement.

In treatment, secure immobility by applying a triangular bandage folded broad over the injured part close to the armpit, knotting it firmly and supporting the forearm in a broad arm-sling.

In FRACTURES OF THE UPPER ARM (HUMERUS), the seat of the fracture may be near to the shoulder-joint, near the elbow-joint or in the shaft between these joints. The cause may be direct, indirect, or muscular violence.

In fracture of the shaft the usual signs of that injury are present. When the break is close to the shoulder-joint, or the elbow, there is great swelling and X-ray examination will be required to elucidate the nature and extent of the damage. The First Aid treatment will be :—

For fracture close to the shoulder-joint, place a thick pad along the inside of the upper arm from the elbow to the armpit.

Fix the upper arm to the chest by means of a broad-folded triangular bandage. The bandage should be applied at about the middle of the upper arm and knotted on the other side of the chest. Support the forearm in a narrow arm-sling.

For fracture of the shaft, bend the forearm at a right angle and keep it in that position. Apply one padded splint outside the upper arm reaching from the point of the shoulder to a point beyond the elbow. Apply another to the inside and reaching from the armpit to beyond the elbow. Before applying them place a small pad in the armpit, exercise extension below and counter-extension above so as to reduce the fracture. Fix the splints by means of two narrow-folded triangular bandages, one above the seat of the break and then one below. Place the forearm in a narrow arm-sling.

Courtesy] [" *X-ray Atlas*," *McKendrick & Whittaker (E. & S. Livingstone)*

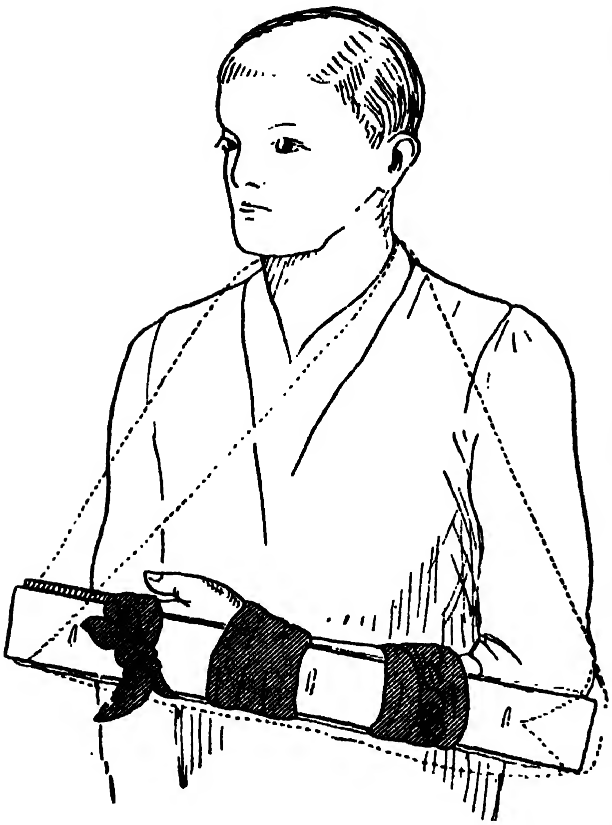
HOW A BROKEN ARM HEALS

X-ray photographs of a badly fractured forearm taken (*left*) soon after the accident, and (*right*) when grafting has taken place.

If the fracture is near the elbow-joint, and if the injury has been incurred indoors, place the limb on a pillow and apply to the swollen elbow either an ice-bag, covered with flannel, or an evaporating lotion, and wait for the doctor. Should the accident have occurred out of doors, fix the injured limb for transport. For this purpose take two pieces of thin flat board, one long enough to reach from the tip of the shoulder to beyond the elbow and the other from beyond the elbow to the tips of the fingers. Fix them firmly together with a narrow-folded triangular bandage so as to make a right angle, and, having well padded them, apply them either to the outside or to the inside of the limb by means of a roller bandage. Support the forearm in a large sling. When home is reached the splints should be removed and cold applied to the limb, which should be supported comfortably on a pillow.

Fracture of the Forearm (Radius, Ulna, or Both) is usually caused by direct violence. When the radius alone is broken, the break is generally just above the wrist; when the ulna alone is broken, the fracture is usually near the elbow-joint. When both bones are broken, the favourite seat of the fractures is the middle and lower thirds of the bones.

Should the olecranon process (the point of the elbow) be broken off, as in falls on the bent elbow, great swelling about the elbow-joint quickly develops. In other fractures the usual signs are generally to be



SETTING A BROKEN ARM—III.
A fracture of the forearm put up with Venetian blind laths.

detected, the deformity, of course, being greater when both bones are broken.

When a detached olecranon can be detected keep the limb in extension and apply an evaporating lotion. For other fractures, make two wooden splints long enough to reach from the tips of the finger to the elbow, and, having padded them, fix them with narrow-fold bandages to the flexed forearm and hand, one on the inner and one on the outer side. See that the flexed forearm has the thumb upwards, *i.e.* the palm of the hand should lie parallel to the chest. The narrow-fold bandages fixing the splints should be applied one above and one below the seat of the fracture, the third bandage fixing the splints to the hand. A large arm-sling completes the treatment.

The Fracture of the Wrist (named Colles' Fracture, after Abraham Colles, a Dublin surgeon), is quite common, the usual victims being elderly women. The usual cause is indirect violence, consequent on a fall on the outstretched palm of the hand. The line of fracture is one inch or less above the wrist, and, being oblique, is nearer the wrist-joint in front than behind. The fragments are commonly impacted (wedged).

The sign is a characteristic deformity which from its outlines has been called the dinner-fork deformity. This may persist after union of the fragments, and there is frequently some stiffness of the fingers and hand owing to adhesions in the wrist-joint and fixation of the tendons. A skiagram will doubtless be taken by the doctor's orders.

Apply an inside and an outside splint (padded) as for fracture of the forearm and support the forearm in a large arm-sling. After these splints have been applied, assure yourself of the continued beating of the pulse at the wrist. This precaution should always be taken when splints are applied to a limb. If no pulse can be felt, loosen the bandages immediately.

Fractures of the Wrist-Bones (Carpus) are a common accompaniment of a sprain the most usual bone to suffer being the scaphoid.

Fractures of the Hand or Fingers (Metacarpus or Phalanges) are due to direct violence, the third and fourth fingers being the most frequent victims. In treatment, apply an inside padded splint to the forearm and hand, and support the forearm in a large arm-sling.

The Lower Extremity.

Fracture of the Thigh Bone (Femur) may take place at the upper end (the neck), in the shaft or at the lower end, this latter usually involving the knee-joint. It may be due to direct or indirect violence.

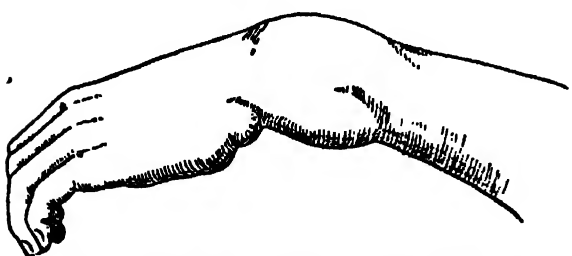
Of the fractures occurring at the upper extremity, there are two varieties, the so-called intracapsular fracture and the so-called extracapsular fracture. The Intracapsular Fracture is most often met with in old people, especially women. Its seat is across the neck of the bone, within the capsule. In elderly people, the bone atrophies and the spaces of the spongy portion are enlarged and filled with fat, the compact tissue encasing it being

thinned. Very trivial violence—a slight stumble, a slip on a kerb or tripping upstairs—quite often suffices to cause the bone to snap. The patient then falls. In the minority of cases, there is impaction, the upper end of the neck being wedged into the spongy tissue of the head.

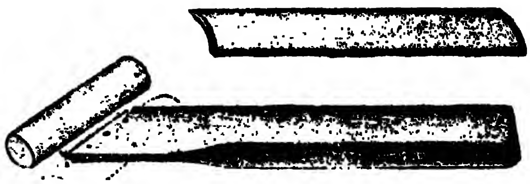
The lower fragment is drawn upwards by muscular action and rotated outwards and backwards. There is thus shortening of the limb and the foot lies on its outer side (eversion). A skiagram will, of course, be taken by the doctor's orders.

The outcome depends upon the physical condition of the victim. If she be healthy and not bronchitic, recumbency for six or eight weeks may bring about bony union. If she be aged and feeble, and especially if bronchitic, the outlook is darkened, and static pneumonia and bed sores may soon determine a fatal result. In such cases, bony union cannot be expected, a fibrous union or a false joint being the only possibility. When there is impaction, the prospects of a bony union are vastly improved.

The Extracapsular Fracture is a break of the neck of the femur near the trochanter, and always involves the hip-joint (whence the inaccuracy of its designation as "extracapsular"). This fracture is due to direct violence, such as a heavy fall on the hip. The severed head and neck are impacted into the junction of the shaft and trochanter. This impaction may be undone by a continuation of the violence, leaving a condition in which three or four fragments are left. Bony union is much more likely in this variety than in the intracapsular, but there is often an exuberant development of callus



THE "DINNER-FORK" DEFORMITY
In a fractured wrist this deformity may persist even after the fragments have joined.



Courtesy] [S. Maw & Sons

A USEFUL ARM SPLINT
This may be used for either forearm by turning over the hinged hand-piece. (Dr. R. Levinson.)

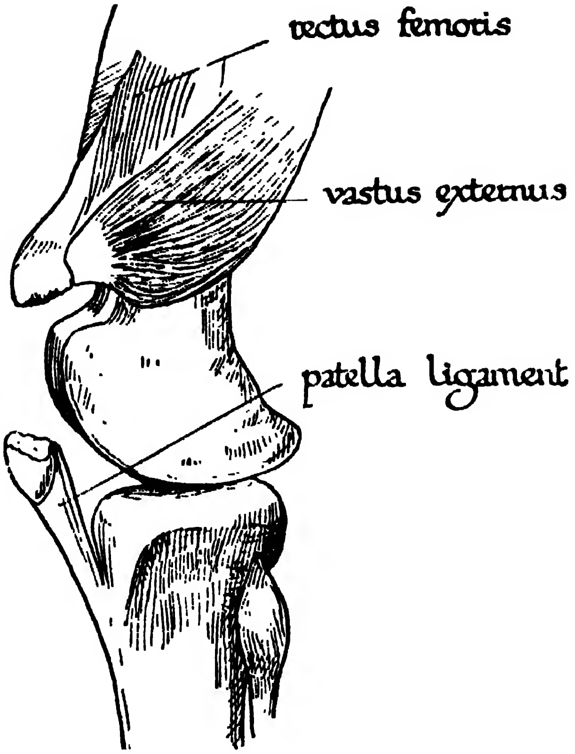
which may limit the subsequent movements of the limb.

The signs are pain, swelling, bruising, slight in the intracapsular variety, often very pronounced in the extracapsular. Crepitus can be felt in each variety, but it is unwise to seek it, especially in the intracapsular fracture of old people. Loss of power is more marked in the extracapsular; eversion, the limb lying helpless on its outer side, is characteristic of both varieties; shortening of the limb is greater in the extracapsular, and may reach 2½ to 3 inches.

The only treatment in both these varieties which the First-Aider can apply is to keep the patient quiet and await the doctor's visit.

FRACTURE OF THE SHAFT is a very common injury. The fracture may be situated in any part of the length of the bone; it is most frequent about its centre and more common at the lower than at the upper extremity. In the upper end of the bone, the fracture is more frequently caused by indirect violence, whilst a break at the lower extremity is generally due to direct force. Either form of violence may be responsible for fracture about the centre. The natural muscularity of the thigh and the great swelling from hæmorrhage renders a diagnosis sometimes difficult. Here a skiagram is most helpful.

The signs are characteristic. In almost all cases displacement is present, its amount depending on the line of fracture and on its situation. In fractures involving the upper third of the bone the small upper fragment is, by muscular action, tilted forwards, abducted and everted, the lower fragment being drawn upwards and inwards. There,



A BROKEN KNEE-CAP
Fracture of the patella with separation of the fragments caused by muscular violence.

is marked eversion of the foot, *i.e.* it lies on its outer border.

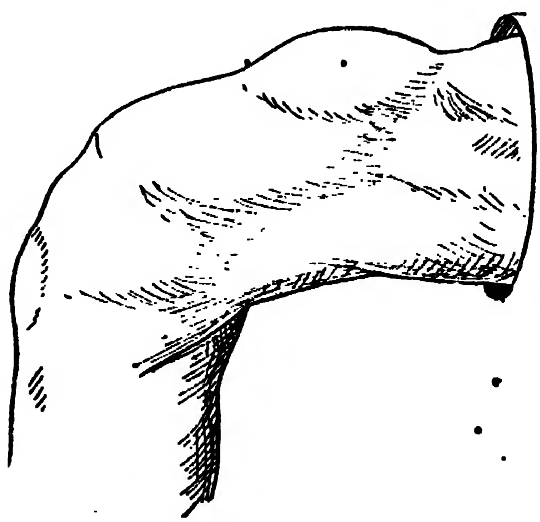
In the middle third, when due to indirect violence, the fragments override or there is angular deformity. There is usually eversion of the foot. If due to direct violence, the fracture will be transverse and there will often be several fragments (comminution).

In the lower third, fractures due to direct violence will be transverse. Here the lower fragment may be tilted backwards by muscular action and may compress or rupture the popliteal artery and so cause gangrene.

There is shortening of the limb, sometimes considerable, in all these varieties of fracture, and the foot is turned outwards. The limb is, of course, powerless.

The First Aid treatment advisable in these cases is as follows: Having, of course, sent a messenger for the doctor, lay the patient on his back and gently and slowly bring the injured limb beside its fellow, being helped in this by two or three assistants, one of whom takes charge of the foot, another is at the upper part of the limb, and the First-Aider opposite the seat of fracture. Direct the assistant in charge of the foot to draw it down *gemtly* so as to bring it into line with the other foot. It is taken for granted that the splints to be applied have been already made and padded. One should be long enough to reach from the armpit to beyond the foot; another should reach from the top of the thigh on the inner side to the knee. While extension—gentle and steady—is maintained by the assistant in charge of the foot, counter-extension being made by the person at the upper part of the limb, the splints are applied over the clothing and secured by bandages: (1) around the chest below the armpits; (2) around the hips; (3) above the seat of the fracture; (4) below the fracture; (5) around the leg; (6) around both ankles and feet and under the soles of the feet as a figure-of-eight. Now tie both limbs together with a narrow-fold bandage. If the patient be a woman, use the other limb as a substitute for the inner splint, tying both limbs together.

In making extension previous to and during the application of the splints, see that the limb attains the same length as its fellow and that the outer edge of the foot is at a right angle with the ground. No jerkiness or violence should be exerted, all



DEFORMITY OF THE KNEE
Caused by incomplete union of the fractured knee-cap.

manœuvres being executed coolly, deliberately and gently.

Transport must be effected very carefully on a stretcher, to which he must be carried by three or four assistants, the First-Aider being in charge of the lower limbs.

FRACTURE OF THE KNEE-CAP (PATELLA) is produced by direct or by muscular violence. The fracture caused by direct violence is generally vertical or star-shaped, and there is frequently much splintering. The fibrous capsule over the bone usually remains intact, so that there is no displacement, the line of fracture being usually mere fissures. There is generally much bruising of the skin, and there may be effusion of blood into the knee-joint. The separation between the fragments can be felt by the examining finger.

The fracture by muscular violence is always transverse, generally complete (through the entire thickness); and, the capsule of the bone being involved, there is considerable separation between the fragments, the superior being drawn up the thigh by the quadriceps extensor muscle. The injury is produced by the sudden contraction of this muscle situated in front of the thigh, when, the knee being half-bent, an attempt is made to recover equilibrium after having slipped. The fragments may be equal in size, but the lower is often the smaller. Either of the fragments may be further fractured vertically or splintered.

The signs are loss of power of the limb, pain, swelling of the knee-joint from effusion of blood, and obvious separation of the fragments, the gap being felt and sometimes seen.

Unless the fragments are wired together, which is the usual modern treatment, bony union is never obtained. The bond of union under the old splint treatment is a fibrous band which commonly stretches when the limb is used. This weakens the limb considerably, the power of extension being lost.

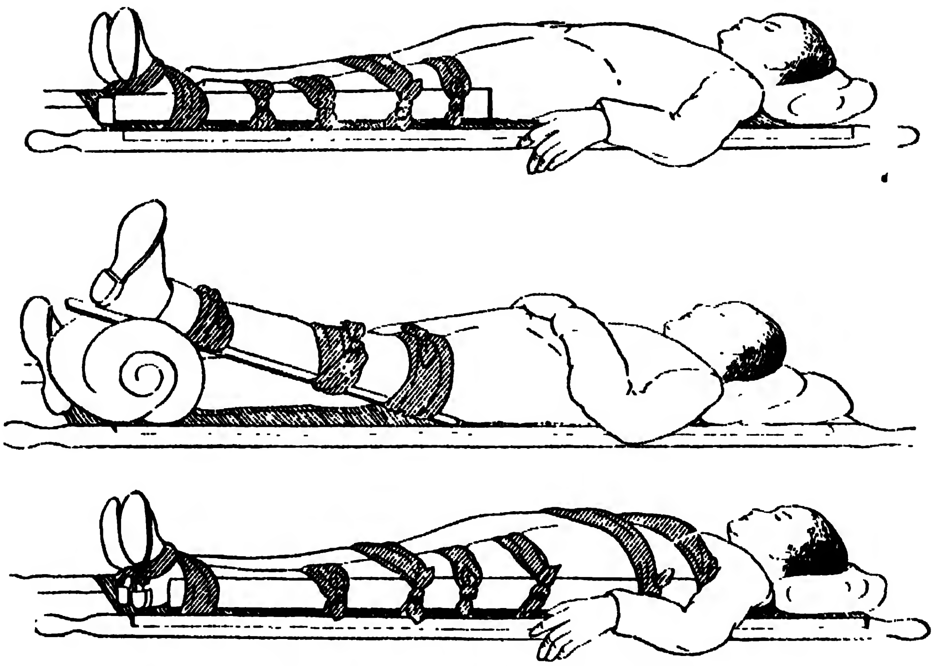
For both varieties of fracture, apply a padded back splint rather wider than the limb, extending from the buttock to the heel. Attach it to the limb by two narrow-fold triangular bandages, one around the thigh and one around the leg. Take another narrow-fold bandage, place the centre below the lower fragment of the fractured knee-cap, carry it backwards, cross the ends over the splint, and, bringing them up, one on each side, knot them above the upper fragment. Raise the foot and the leg on a high pillow and it is advisable also to raise the head and shoulders.

AN IMPROVISED LEG SPLINT
An umbrella used as a temporary splint for a broken leg.

In FRACTURE OF THE LEG (TIBIA AND FIBULA), one or both bones may be broken. This is the commonest fracture admitted into hospital wards.

Fractures of the Tibia alone may be situated at the upper end or in the shaft; a third variety is separation of the internal malleolus. These are the result of direct violence. In fracture of the shaft, its existence is confirmed by feeling an inequality on running the fingers along the skin. Pain is also felt at the seat of the irregularity on grasping the bone above and below. The intact fibula acting as a splint, there is little displacement, although the lower end of the upper fragment, generally pointed, is tilted forwards, and may, by careless handling, easily pierce the skin.

Fractures of the Fibula alone are usually caused by direct violence, and are fairly common. The intact tibia acting as a splint, there is no displacement, but pain at the seat of the fracture can be evoked by compressing the bone above and below ("springing" the fibula). A radiograph will easily localise the break.



FIRST-AID METHODS OF SETTING A BROKEN LEG
(1) A broken femur or thigh bone set with a long splint; (2) a fractured patella put up with a back splint; (3) a broken leg set with two side splints.

In all these fractures beware of rough handling, especially when the tibia is broken, when the danger of a conversion of a subcutaneous fracture into the open variety is very real.

Pad two splints, each to each from just above the knee-joint to beyond the foot, and fix them to the inner and the outer surface of the leg by means of three narrow-fold triangular bandages: (1) to the thigh above the knee; (2) above the seat of the fracture; (3) below the seat of the fracture. Tie the two limbs together at the knees and at the feet, a figure-of-eight being used at the latter situation.

Fractures of both bones, due to either direct or indirect violence, are very common. If due to direct violence, both bones yield at the seat of the blow. If due to indirect force, the tibia gives way at its weakest part, viz., the junction of its middle and lower thirds, the fibula breaking at a somewhat higher level. The fractures are often oblique. There is well-marked shortening of the limb from the drawing upwards by muscular action of the calf muscles of the lower fragment which is also often rotated outwards by the weight of the foot. The usual signs of fracture are obvious. There is great risk of the fracture being converted into an open one from the penetration through the skin of the sharp end of the upper fragment.

Fractures in the neighbourhood of the ankle-joint, usually the result of indirect violence (a slip) are, primarily, a dislocation of the joint leading to a secondary fracture. These fracture-dislocations, of which there are two varieties (Pott's Fracture and Dupuytren's Fracture) are serious injuries often leading to considerable permanent disablement.

In Compound Fracture of the Tibia, a good First-Aid hammock for the injury may be improvised as follows: A roll of clothing wide enough to extend from above the knee to beyond the foot is taken; two sticks, somewhat longer than the width of the cloth, are rolled into each edge of the clothing so as to form a cradle. The leg is placed in the cradle and secured by three narrow-fold bandages—above the knee, above and below the seat of fracture, and finally as a figure-of-eight at the ankle. The patient must, of course, be removed on a stretcher.

Fractures of the Bones of the Foot (principally fracture of the Os Calcis or of the Astragalus) are caused usually by direct violence, and are frequently of a severe character. When the patient has been put to bed, keep the foot raised by placing a small pillow beneath it. The treatment is as for fracture of the leg.

ASPHYXIA

A CESSATION of respiration brings about the conditions called Asphyxia. There is provided for the maintenance of respiration a nerve-centre, situated in the medulla oblongata of the brain. When this centre is deprived of oxygenated blood, asphyxia declares itself.

The exclusion of oxygen from the blood may be brought about in various ways. There may be direct obstruction of the air-passages, as in croup, where the formation of a membrane in the larynx prevents the entrance of air into the lungs. In the same way, a foreign body (such as a piece of meat or false teeth) may find its way into the air-passages, or a growth in the larynx or outside it may be the obstructing factor. Then, again, strangulation (hanging, smothering) may be the cause; or a child may, by swallowing boiling water from a kettle-spout, be asphyxiated by the swelling of the laryngeal mucous membrane thus induced. Drowning may be the cause, the water occupying the respiratory gangway to the exclusion of the air. Instead of air, a gas devoid of oxygen may be inspired (chloroform, coal or water-gas, lime-kiln gas, carbonic oxide from a charcoal stove, sewer gas, marsh gas). The respiratory muscles may be disabled as in a crowd-crush or a fall into a heap of sand, or in the accidental overlying of a baby by its mother. A fracture of the spine above the fourth cervical vertebra brings about instant death from the cutting off from the diaphragm of its nerve.

When the exclusion of oxygenated blood from the respiratory centre is continuous, the three following stages of asphyxia succeed each other:—

(1) Dyspnœa (difficulty of breathing), characterised by the exaggeration of inspiratory and expiratory movements.

(2) Convulsive and irregular breathing, in which the expiratory efforts are the most marked. This culminates in general convulsions of all the muscles of the body.

(3) Exhaustion. Here there is general insensibility, with coldness and blueness of the surface of the body. An occasional long-drawn but feeble inspiratory effort is made; these movements gradually cease and death supervenes.

The blood-pressure rises rapidly during the first and second stages, owing to the action of the de-oxygenated blood on the vaso-motor centre, in close proximity to the respiratory centre in the brain. In the third stage, the blood-pressure, largely owing to heart-failure, falls as rapidly as it rose. The lungs, the right side of the heart, the pulmonary artery and the systemic veins become gorged with venous blood.

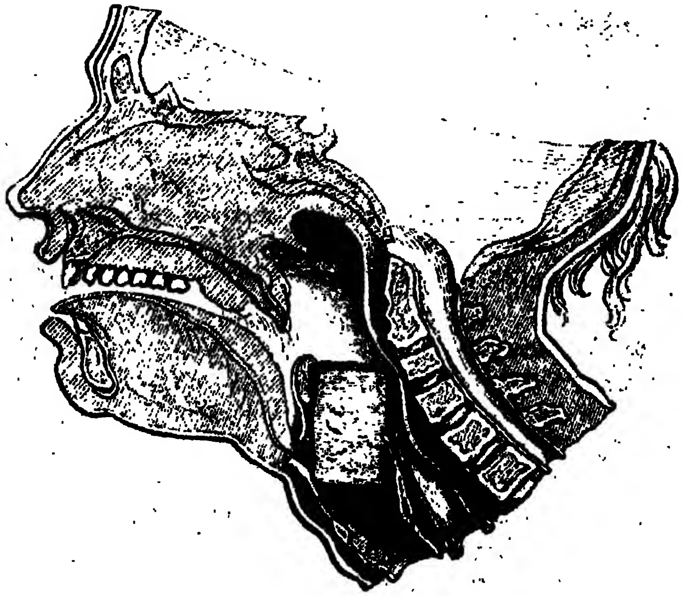
The main points to seize in the study of asphyxia are that the condition is due to the accumulation in the blood of carbonic acid; that insensibility comes on *very soon*, and is succeeded by paralysis of all the voluntary muscles and of the muscles of respiration; that the heart's action may continue for a long time after the abolition of muscular action.

The actual cause of death is, in all probability, the abnormal distension of the right chambers of the heart. It must be borne in mind that artificial respiration subserves recovery not only by re-oxygenating the blood, but by unloading the right ventricle in consequence of the restoration of the pulmonary circulation. The heart's action persists after muscular action and breathing have ceased. *While the pulse can be felt, artificial respiration may succeed* in resuscitating the patient.

The indications are to remove promptly the cause of the condition and to have immediate recourse to measures calculated to re-oxygenate the blood and to relieve the over-distension of the right heart by re-establishing the circulation through the lungs.

The two last indications are fulfilled by Artificial Respiration. Various methods of performing this operation have been invented. Of these, four shall be described, viz.: (*a*) Schafer's Method; (*b*) Silvester's Method;

Artificial Respiration.



Courtesy] [" Forensic Medicine," H. Littlejohn (J. & A. Churchill)

ASPHYXIA CAUSED BY CHOKING

A diagrammatic section through the head and neck in a case of suicide, showing how the air-passage was blocked by a cork.

(*c*) Laborde's Method ; (*d*) The Mouth-to-Mouth Method.

In applying each of these methods, certain precautions must be taken.

(1) Promptitude. If the First-Aider has had the advantage of attending ambulance demonstrations, he cannot fail to have noticed that the manœuvres incidental to artificial respiration are performed in leisurely fashion. When a real patient has to be dealt with, no "humming and hawing" is permissible ; if intervention is to be of any use, it must be promptly made.

(2) Precipitation must, however, be avoided. Most would-be First-Aiders perform artificial respiration much too quickly, and sometimes so roughly that fractured ribs have been known to be the consequence. The respiratory act, made up of inspiration plus expiration, should not be repeated more frequently than twelve times a minute for an adult, twenty times a minute for a child. The movements employed for admitting air to the lungs and for expelling it therefrom should be slow but forcible. Hence, no precipitation or roughness ; but be not too ladylike.

(3) Watch the patient. After the natural breathing is re-established, it may again cease. It is, therefore, necessary to watch the respiration for some time after apparent recovery. Remember that you have to deal with an exhausted respiratory centre and that artificial respiration may have to be repeated.

(4) Before practising artificial respiration any article of clothing constricting the neck, chest or abdomen must be *quickly* removed.

Schafer's Method.

Schafer's (the prone) Method has several advantages over the Silvester Method. It is easy of execution ; it makes no great call on the muscular energy of the operator ; the tongue does not fall back into the pharynx and so block up the air-passages ; in cases of drowning, the prone position facilitates the escape of water and mucus from the mouth and respiratory passages ; the gaseous interchange is more complete than in any other method ; finally, there is less risk of injuring the ribs and the abdominal organs.

The *modus operandi* is to clear the mouth and nostrils ; place the patient with his face downwards and turned to one side ; extend both his arms above his head, taking care to keep his mouth and nostrils free from obstruction. Kneel across buttocks or on one side of the patient, facing his head. Keep both his upper limbs extended ; place both hands flat over the lowest ribs, one on each side, and slowly and gradually throw the weight of your body on to your hands so as to exercise slow, firm and downward pressure (but not violent) on the chest. Then raise your body *slowly* so as to remove the pressure, but leaving your hands in position. Repeat this double movement about twelve times a minute and continue these movements until the natural respiration has returned, or, *if this be absent*, for at least two hours. Let no pause separate the forward from the backward movement of your body.

COMMON CAUSES OF POISONING
Poisonous plants which are familiar in the English countryside.

The Silvester Method has three serious disadvantages. It makes a great call on the endurance of the operator; the patient's tongue is apt to fall back into the pharynx and so obstruct the respiratory passages; and his supine position (on the back) does not favour the escape of water, vomited matter and mucus from the mouth.

The Silvester Method.

Clear the mouth and nostrils as in all the methods. Place the patient on his back, do away with all constriction about the neck, chest or abdomen (braces, belts, collars, etc.). Place a small but firm roll of clothing under the patient's shoulders so as to throw out the chest, extend the neck and allow the head to fall back. In this way the chin is held up; and, in consequence, the tongue does not fall back. It is safer, however, to have the tongue drawn and kept out of the mouth by an assistant who holds it with the corner of a handkerchief between his finger and thumb. Kneel at a comfortable distance behind the patient's head, seize the forearms just below the elbows, carry them over the head outwards, upwards and then downwards, and make the elbows touch the ground behind patient's head. The chest walls are thus expanded; and, generally, air can be heard to enter the glottis. After two seconds, bring the arms down in opposite directions and press them against the ribs with the forearms crossed over the pit of the stomach. Bring your weight to bear firmly on the forearms so as to press up the diaphragm. This last movement should elicit a grunt from the patient—a proof of its efficacy. Keep up this pressure for two seconds. Repeat this double movement gently, firmly and deliberately at the rate of fifteen times a minute. When the natural respiration has recommenced, interrupt the movements.

The First-Aider must not feel discouraged when he reads that two hours' artificial respiration may be necessary. Cases of asphyxia due to electric shock have been restored after four hours' artificial respiration. He can be relieved by an assistant at the end of a quarter of an hour. In many instances, natural breathing will be resumed in a few minutes.

Laborde's Method is of great use in the case of children asphyxiated by poisonous gases, in cases of electric shocks, and when the arms and the ribs are fractured. The method is founded upon the discovery of Professor Laborde, of Paris, that rhythmic traction of the tongue is an efficacious means of restarting suspended respiration.

Laborde's Method.

Place the patient as in Silvester's Method, or on side. Clear the mouth and nostrils, depress the chin, seize the tip of the tongue between the folds of a handkerchief, pull, or rather, *jerk* it forwards, then allow it to return into the mouth, but still retaining your hold. Repeat these movements fifteen times a minute (twenty times in the case of a child).

The Mouth-to-Mouth Method is sometimes very successful in young children under the age of five years.

Mouth-to-Mouth Method.

Kneel down by the side of the child; lay your hand over the stomach to prevent its inflation; place your lips over the child's mouth and expel your breath as in blowing smoke out of the lungs in smoking. Put a handkerchief around the child's mouth and over its nostrils. After forcibly emptying his own lungs, the First-Aider should remove his hand from the stomach and release his grasp on the nostrils while gently pressing upwards and inwards the lower ribs so as to expel the air breathed into the child's lungs out again. Repeat these movements from fifteen to eighteen times a minute.

SPECIAL CASES OF ASPHYXIA

Drowning results when the air-passages are filled with sufficient water to prevent the performance of the respiratory function. We must bear in mind that, in addition to asphyxia, shock is generally well marked, and that *exhaustion* (from strenuous struggling) and *exposure to cold* are prominent causes of the condition in which the patient is found.

Drowning.

What is the duration of total immersion

ARTIFICIAL RESPIRATION—SCHAFER METHOD—I.
Showing the position of the patient—with his face downward and turned to one side and arms extended—and the first-aider kneeling across his body with hands flat over the lowest ribs.

in water that entails asphyxia? It is probable that a few seconds will suffice for the beginning of asphyxia, and that, at the farthest, this may be prolonged to one minute or one minute and a half. But asphyxia is by no means synonymous with death. However lifeless the victim may appear to be, artificial respiration should be resorted to and persevered in for *at least* two hours. Restoration has been found impossible in some whose immersion had lasted only one minute; on the other hand, success has crowned efforts in the case of those who had been immersed for five minutes.

Dr. Woolley, for many years Medical Officer to the Royal Humane Society, failed to find in the society's records more than two cases of recovery after five minutes' immersion. The chances of those who faint, and who, consequently, make no effort to breathe when immersed, are increased as compared with those of persons who struggle violently, and so induce a condition in which the air-tubes are clogged with mucous froth.

It is recommended that artificial respiration of the apparently drowned be persisted in *for some hours*, except when the body, long under water, is cold and rigid. A case is cited in which, after fourteen minutes' mimersion, no signs of returning animation were seen until after treatment had been persevered in for eight and a half hours.

A person withdrawn from the water after immersion will present the following appearances: The face is puffed and

ARTIFICIAL RESPIRATION—SCHAFER METHOD—II.
The weight of the first-aider's body is thrown slowly and gradually on to his hands, then his body is raised slowly, removing the pressure without moving his hands. The movements are repeated twelve times a minute without pause.

cyanosed (purple); there is lividity of the lips; the eyes are bloodshot; the stomach is more or less filled with water; the body is cold and the air-passages contain watery mucous froth.

ARTIFICIAL RESPIRATION—SILVESTER METHOD—I.
Bring the arms over the head outwards, upwards, and then downwards; pause; bring the arms down in opposite directions, cross the forearms on the chest and press them firmly for two seconds; repeat.

To TREAT THE APPARENTLY DROWNED, summon immediately medical assistance, and proceed at once to *restore the respiration*. Directly natural breathing is noticed, adopt measures to *promote circulation* and to *restore the warmth* of the body.

Do not lose time by removing the clothing (rip off any that is tight), but place the patient (dressed) face downwards on the ground and lift him face downwards so as to allow the water to flow from his stomach and lungs. Apply Schafer's prone method as it has been described: continue this for two hours at least, or until natural breathing has restarted. Even when this measure of success has been obtained, watch the patient for fear the breathing should again fail. In this eventuality, resume artificial respiration. While artificial respiration is proceeding, get bystanders to apply hot-water bottles, hot bricks, etc., adequately protected with flannel, to the feet, and to rub the surface of the body towards the heart.

As soon as natural breathing has begun, take measures to restore warmth and circulation. Replace his clothes with warm blankets, continue the friction of the body in a direction towards the heart, apply hot bottles to the pit of the stomach, inside the thighs and to the armpits. When the power of swallowing has returned, give small

ARTIFICIAL RESPIRATION—SILVESTER METHOD—II.
A small roll of clothing is placed under the patient's shoulders to throw out his chest, and an assistant prevents his tongue from slipping back into his throat—the final position, pressing the arms on the chest.

quantities of wine, beef tea or coffee, or warm brandy or whisky and water. Then remove him in recumbent position on stretcher, put him into a warm bed, and allow him to sleep under your watch and guard. Some difficulty of breathing may be experienced; large linseed and mustard poultices spread thin back and front of the chest will relieve this trouble. On no account should the patient be urged to drink until his swallowing powers have returned.

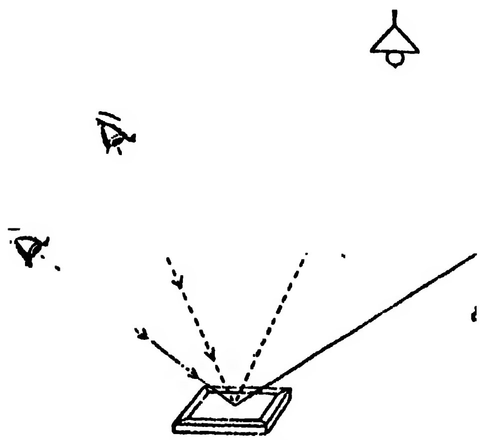
Choking.

In asphyxia from choking, the foreign body may lodge in the commencement of the gullet or in the air-passages. A very common accident is the arrest of a bit of meat at the narrowest portion of the gullet, behind the cricoid cartilage (just below Adam's Apple).

Send for the doctor. Make an attempt to hook the obstruction with the finger and so extract it. If the patient be a child, invert it and slap it vigorously on the back. Should asphyxial symptoms supervene after the offending body has been extracted, resort to artificial respiration.

Strangulation.

In asphyxia from strangulation or hanging, the first thing to do is to release the patient, remove him to the fresh air and loosen his clothing. Encourage breathing by dashing cold water on his chest and face and be ready to apply artificial respiration.



REFLECTION TEST FOR SIGNS OF LIFE

The slightest movement of the chest-walls can be detected by watching the reflection of some bright object in a mirror placed on the patient's chest. The figure shows how the reflection may be found.

Swallowing Corrosives.

Asphyxia from swelling of the mucous membrane of the glottis is frequently the result of the propensity of children to drink from the spout of a kettle of boiling water; in adults, it may be due to swallowing corrosive poisons.

Having dispatched a message for the doctor, wrap the child in a blanket, keep him sitting up in a chair before a fire, and apply an ice-bag or hot fomentations to the throat. Should signs of asphyxia reveal themselves, perform artificial respiration.

Poisonous Fumes.

Asphyxia may result from inspiring unbreathable or poisonous gases such as charcoal vapours, coal and water gases, fumes from brick and cement-kilns, sewer and cesspool gases, or choke-damp in mines.

The chief noxious ingredient in coal gas is carbonic oxide. In the gaseous products of lime-kilns, the poisonous agents are carbonic acid, carbonic oxide and sulphurous acid. Brick-kilns emit carbonic acid and carbonic oxide. In water gas (made by passing steam over hot coke) the gases evolved are hydrogen and carbonic oxide, the latter, in the proportion of 40 per cent., being the noxious agent. The dangerous gas found in mines (choke-damp), cellars and wells is carbonic acid. In sewers and cesspools the chief poison is sulphuretted hydrogen. In brewers' vats, carbonic acid is the dangerous emanation.

Remove the patient into the fresh air, loosen tight articles of clothing, apply the Schafer method of artificial respiration and administer oxygen (procurable at most chemists). Keep the patient *lying down*, apply warmth to the body and encourage the circulation by friction of the limbs towards the heart. A stimulant may advantageously be given when recovery is somewhat advanced. The rescuer should, by wearing a wet cloth as a respirator and by expedition in his rescue work, protect himself from being a second victim.

THE SIGNS OF DEATH

A knowledge of the usual signs of death will prove useful to the First-Aider. They are as follows:—

[Topical

OVERCOME BY PETROL FUMES
Winners of the Southern Railway Ambulance Competition treating a "patient." The rescuers wear wet handkerchiefs to protect themselves from the fumes.

RESPIRATION.—If the usual movement of the chest-walls peculiar to respiration be totally absent for the space of five minutes, death may be presumed to have taken place. In order to render this observation more evident, a full glass of water may be placed on the chest; the absence of any movement of the liquid will tell in favour of death. In like manner a mirror (an even piece of looking-glass or plate glass, or a basin of water or mercury) may be placed on the front of the chest and the image of some object illuminated by the window or other strong source of light be found in it. The slightest motion of the reflecting surface will be shown in the image of the object. Hold also a bright surface, such as that of a mirror, to the mouth. If not dimmed by the condensation of moisture from the breath, respiration has ceased.

HEART'S ACTION.—If no pulse can be detected at the wrist or in the temple in front of the ear, and a string, tightly tied around a finger, produces no redness at the end of the digit and leaves no white ring when removed, life may be considered extinct.

WAXY PALLOR AND COLDNESS OF THE SURFACE.—These signs go on increasing as the moment of death becomes more remote.

RIGOR MORTIS.—This, if present, is an absolute sign of death. Its onset varies from ten minutes to seven hours after death. The later it appears, the longer it lasts. It appears earliest in the neck and lower jaw, then in the upper extremities and finally in the lower limbs. It disappears in the same order. It may be necessary to explain that rigor mortis is a stiffening of the body which takes place after death, and is caused

by contraction of all the muscles of the body, the posture assumed being that of rest or repose.

Eyes.—In cases of catalepsy (trance) simulating death, the pupil contracts under a strong light and dilates on its withdrawal. In real death, the pupil is unaffected by light.

POISONS

POISONS are substances which, when taken into the body, are capable of seriously affecting the health or of causing death.

Poisons are divided into Irritants and Neurotics (narcotics). The first irritate and inflame the alimentary canal (stomach and bowels). Many substances of this class possess corrosive properties; such are the strong mineral acids, caustic alkalies, corrosive sublimate, bromine, etc. These, as they are swallowed, have an acrid or burning taste, this burning being felt from the mouth as far down as the stomach. Other irritants have no corrosive action; such are arsenic, barium salts, carbonate of lead and cantharides (Spanish fly). These, unlike the corrosives, have no destructive action on the tissues with which they come in contact. They simply irritate and inflame them. When a corrosive poison is swallowed, symptoms appear immediately. When an irritant poison is taken, symptoms rarely manifest themselves in less than half an hour. If, then, symptoms show themselves immediately on swallowing the poison, and an examination of the mouth and throat reveals a decided destructive chemical action on the tissues, we may diagnose corrosive poisoning.

Irritants.

Neurotics or Narcotics are poisons which act upon the nervous system. Either immediately or later the patient suffers from headache, giddiness, numbness, paralysis, stupor or convulsions. The acrid burning taste of corrosives is wanting; and they rarely occasion vomiting or purging. The pure narcotics have no irritating action on the stomach or bowels. They belong chiefly to the vegetable kingdom (opium, belladonna, chloroform, alcohol, prussic acid).

Narcotics.

Some poisons have a compound action. Chiefly derived from the vegetable kingdom, they first give rise to vomiting and purging, like irritants; then there supervene nervous symptoms such as stupor, paralysis and convulsions. Such compound poisons are nux vomica, aconite, hemlock, and poisonous mushrooms. The onset of these symptoms after a meal composed of suspicious vegetables will often point out the class to which the poison belongs. Some of these poisons have an acrid, hot taste, while others, like aconite, cause tingling or numbness; others, again, being intensely bitter, as nux vomica, strychnine, picrotoxin. Notwithstanding these exceptions, the First-Aider will find the classification given above very useful.

The evidences of poisoning are as follows:

(1) The symptoms appear suddenly in a previously healthy person. Thus, the symptoms of poisoning by nicotine (the alkaloid of tobacco), prussic acid, oxalic acid or strychnine generally show themselves in a few minutes after ingestion. Those caused by arsenic and other irritants and by all poisons generally, appear from ½ to 1 hour.

Evidence of Poisoning.

(2) The symptoms appear soon after a meal or soon after some kind of food or medicine has been taken.

(3) When of several people, partaking of such a meal or medicine, all exhibit similar symptoms, it is evidence of poisoning.

(4) The discovery of poison in the food eaten, in the medicine taken, in the vomit or in the excretions.

The First-Aider should always, in these cases, take a rapid glance around, and notice any suspicious odour; a bottle or tumbler may lie near the patient, containing, perhaps, the remains of the poison taken.

In cases of poisoning, send immediately for medical aid, with information pointing to poisoning. Should you be in the dark as to the identity of the poison taken, adopt the general measures

Treatment.

detailed below. If, however, you have no doubt as to this identity, give the appropriate treatment. Be sure to put carefully on one side, for future inspections by the doctor, the contents of bottles, tumblers, etc., and all vomited matter whether on the clothing or on the floor.

If the poison is unknown :

(*a*) Rid the system of any poison not yet absorbed ; for this purpose, provided that the patient's mouth is not burned, give an emetic or an aperient.

(*b*) Combat shock by means of stimulants and warmth to the surface.

(*c*) Relieve local pain, such as exists in corrosive or irritant poisonings, by administering such soothing beverages as milk, barley-water, arrowroot, olive oil, linseed tea, gruel, etc., or by applying poultices.

The following emetics may be used :

Emetics.

COMMON SALT (Two tablespoonfuls in a tumblerful of warm water). A rather uncertain emetic, but it is always at hand.

MUSTARD (FLOUR OF).—A tablespoonful in half a tumblerful of warm water. This is always available.

SULPHATE OF ZINC.—Thirty grains in half a tumblerful of tepid water. This is the best routine emetic, and it generally acts promptly. If salt has already been given as an emetic, do not give the zinc sulphate, as caustic chloride of zinc may be thus formed in the stomach.

POWDERED IPECACUANHA.—Thirty grains in half a tumblerful of warm water.

IPECACUANHA WINE.—Two tablespoonfuls in an equal quantity of warm water. This is not a prompt emetic.

SULPHATE OF COPPER.—From five to ten grains in a tumblerful of warm water. This is the next most reliable emetic after the sulphate of zinc.

CARBONATE OF AMMONIUM.—Thirty grains in a tumblerful of water.

The best emetic is the one most promptly procurable. Many people are but too ready to vomit, a draught of greasy, tepid water, followed by the introduction of the finger into the throat, being often quickly efficacious.

The action of emetics is reinforced by plenty of tepid water. In narcotic poisoning it is often very difficult to induce vomiting.

Do not give emetics in cases of corrosive poisoning (shown by burns and stains on fingers, lips, etc.).

Aperients.

The safest aperient is CASTOR OIL (from one to two tablespoonfuls). EPSOM SALTS (sulphate of magnesium) may be given (one tablespoonful in a tumblerful of cold water). To children, give smaller doses.

The following stimulants may be used :

Stimulants.

SAL VOLATILE (aromatic spirits of ammonia). Give from half to one teaspoonful in a tumblerful of cold water.

WHISKY OR BRANDY.—From a teaspoonful to a tablespoonful (diluted) according to age.

BEEF TEA, TEA OR COFFEE.

SOME COMMON POISONS AND THEIR TREATMENT

The following poisons show the same symptoms :—

ANTIPYRINE
ANTIFEBRIN (ACETANELID)
PHENACETIN
EXALGINE
RESORCIN

These symptoms are : (1) vomiting ; (2) blueness of face ; (3) skin abundant sweat. Sometimes rash like measles or scarlatina ; (4) collapse—pulse feeble, irregular. Breathing slow.

TREATMENT.—(1) emetic ; (2) alcoholic stimulants ; (3) hot-water bottle to extremities ; (4) artificial respiration ; (5) maintain recumbency.

The common corrosive acids are :—

The Acids.

(1) ACETIC (Glacial, Aromatic Vinegar).
(2) HYDROCHLORIC ACID (Muriatic Acid, Spirit of Salt).
(3) NITRIC ACID (Aqua Fortis).
(4) SULPHURIC ACID (Oil of Vitriol).

SYMPTOMS.—Those of corrosive poisoning. (1) Burning pain in mouth, throat and

stomach. (2) Great thirst. (3) More or less inability to swallow or speak. (4) Vomiting of blood (modified by gastric juice to brown or black colour), and shreds of membrane. (5) Generally constipation. Urine suppressed. (6) Possibly convulsions. (7) Great collapse, with its usual symptoms. (8) If stomach is perforated, signs of peritonitis. (9) Tissues and clothing stained. If hydrochloric acid, tissues and skin dull white, clothing red. If nitric acid, tissues and skin bright yellow, clothing yellow, red or brown. If sulphuric acid, tissues and skin white, changing to brown or black, clothing brown. If oxalic acid, tissues and skin white or brown, clothing brown or orange-red.

TREATMENT.—

1. *Avoid emetics*, but give one of the following antidotes: (*a*) whitening; (*b*) chalk; (*c*) wall plaster; (*d*) sodium carbonate with plenty of water; (*e*) magnesium carbonate (½ oz. in tumbler of water and repeat).
2. Give one of the following: milk and egg, olive oil (¼ pint in 1 pint of water), gruel.
3. Combat shock.

If **OXALIC ACID** has been taken, avoid emetics, and give any of the first three antidotes above mentioned, or lime water or 1 drachm, repeated frequently, of saccharated solution of lime. Afterwards, give castor oil (6 teaspoonfuls).

CARBOLIC ACID.—SYMPTOMS.—As in corrosive poisoning, with, in addition, smell of carbolic, white hardened stains of lips and mouth, green or black urine, nervous symptoms such as stupor, anæsthesia, severe pain in stomach, hardening of abdominal muscles, vomiting of blood-stained matter and shreds of mucous membrane.

TREATMENT.—Give ½ oz. of Epsom salts in 1 pint of warm water, or saccharated solution of lime, 1 drachm in 1 pint of water. Later, give olive oil (¼ pint in 1 pint of water); milk freely; white of egg in water freely. Give abundant stimulants, maintain bodily warmth, and, if necessary, perform artificial respiration.

The common non-corrosive acid is **PRUSSIC (HYDROCYANIC) ACID**. This may be contained in oil of bitter almonds, almond flavouring, bitter almond water and in **CYANIDE OF POTASSIUM.**

SYMPTOMS.—These show themselves in the act of swallowing or very shortly afterwards. They are: giddiness, staggering, loss of muscular power, insensibility, panting respiration, sometimes convulsions, severe collapse. The breath may smell of bitter almonds.

TREATMENT.—This poison acts with great rapidity; the treatment must, therefore, be prompt. If seen *immediately*, after the poisonous dosing, pull patient into the open air, give an emetic and apply a cold douche to head and spine. While the douche is being given (dashing cold water will do as well), perform artificial respiration and make him inhale ammonia by the nostrils. In the meantime, get a druggist to dispense the following antidote:

THE TREATMENT FOR SHOCK
An improvised bed with rugs and hot-water bottles—applied to feet, armpits, and heart area—devised to combat shock by means of warmth.

Sulphate of Iron, 15 grains; Tincture of Perchloride of Iron, 20 drops; 1 wineglassful of water; then add Magnesium Carbonate, 1½ drachms, previously made into a paste with water. Mix and give as one dose. Repeat if necessary. If the patient does not succumb in half an hour, there is a good prospect of recovery.

The common caustic alkalies are:—

Caustic Alkalies.

(1) CAUSTIC POTASH,
(2) CAUSTIC SODA,
(3) SOAP LEES
(4) STRONG AMMONIA.

SYMPTOMS.—Gastro-intestinal symptoms, as in corrosive poisoning. There is also painful purging with sometimes the passage of blood; the body is cold, the countenance anxious, and the pulse rapid and weak.

TREATMENT.—*Do not give an emetic.* Neutralise the alkali with draughts of freely diluted vinegar, citric acid in water, tartaric acid, ½ drachm in ½ pint of water, repeated. Afterwards, give milk freely, or olive oil (¼ pint in 1 pint of water), or raw white of egg. Give stimulants.

Other poisons include:—

Other Poisons.

ACONITE (MONKSHOOD).—May be taken by mistake in the form of aconite liniment.

SYMPTOMS.—Tingling and numbness of mouth and tongue and tips of fingers, and a feeling as if ants were crawling over the body; nausea, vomiting and pain in stomach region; difficulty of breathing; weak, irregular pulse; cold, clammy skin; pallor; giddiness; weighty feeling of limbs; mind clear.

TREATMENT.—Emetics, cold douching, stimulants, hot coffee (if unable to swallow, inject it or diluted brandy into the bowel by an enema syringe); warmth to extremities; mustard leaf over the heart; keep the patient recumbent; artificial respiration for two hours, if necessary.

ALCOHOL may be rectified, proof or methylated spirits, whisky, brandy, gin, rum, etc.

SYMPTOMS.—Face flushed, eyes bloodshot, pupils dilated and fixed, moist skin, giddiness and unsteadiness of gait, confusion of

AN ANTIDOTE FOR ACID POISONING
Mixing plain chalk and water—a useful antidote for poisoning by acids such as nitric, acetic, hydrochloric, or sulphuric.

thought, thickness of speech, convulsions, stupor, coma. Sudden death may occur some hours or days after apparent recovery.

TREATMENT.—Give 30 grains of ammonium carbonate, dissolved in half a tumblerful of water; rouse the patient with cold douching; give him hot coffee; apply hot bottles to extremities; commence artificial respiration at once if breathing fails.

ANTIMONY.—(Tartar Emetic, Chloride or Butter of Antimony, Antimonial Wine, fly-papers, Hammond's Vermin Remedy).

SYMPTOMS.—Apparently usually in from 15 to 60 minutes, they are: burning heat and constriction of throat, difficulty in swallowing; nausea and persistent vomiting and purging; pain in the stomach and abdomen; cramps in legs (calves). There may be suppression of urine or delirium,

paralysis and coma; collapse (skin cold, clammy; pulse small, irregular or imperceptible).

TREATMENT.—If vomiting is present, encourage it with draughts of warm water; if absent, give an emetic. Give strong tea or tannin (30 grains in warm water), and repeat as often as vomiting occurs. When no more vomiting, give white of egg in water or milk freely. Combat collapse with stimulants and warmth to extremities.

ARSENIC (Arsenious Acid, White Arsenic).—As in fly-papers, Fowler's Solution, Vienna and Scheele's Emerald Green, Simpson's Rat Paste, cheap ices, French chalks, wall-papers, tinned fruits and beer.

SYMPTOMS.—The same as in poisoning by Antimony.

TREATMENT.—Give an emetic and see that it acts. Then administer dialysed iron, obtained from a pharmacist, in frequently repeated doses of one tablespoonful until ten have been taken, each dose being followed by a little common salt in a little water. Follow this up with milk and eggs, olive oil ($\frac{1}{4}$ pint in 1 pint of water), or barley water. Combat collapse with stimulants, give ice for thirst and maintain the bodily heat. Should dialysed iron be unprocurable, give magnesia in free doses.

BELLADONNA (Deadly or Woody Nightshade, Garden Nightshade).—The poisonous alkaloid, atropine, is contained in the leaves, root and berries.

SYMPTOMS.—The secretions are stopped; hence there is thirst and great dryness of the throat and skin and the urine is suppressed. The face is flushed, the eyes are sparkling, the pupils widely dilated, the pulse is quick, the respiration slow and deep, and there is purging and delirium. There may be a rash resembling that of scarlet fever.

TREATMENT.—Give an emetic. After it has acted, give stimulants and a cupful of hot, strong coffee. Apply warmth to the extremities and perform artificial respiration.

CANTHARIDES (Spanish Fly, Blistering Fluid).

SYMPTOMS.—Burning pain in the throat and stomach, with difficulty in swallowing; vomiting and diarrhœa. The mucus and blood in the dejecta may show shining particles of the powder (cantharides is the dried beetle reduced to powder, which contains shining green particles). There is salivation and swelling of the salivary glands; persistent desire to pass urine, only a small quantity or a little blood being voided. There may be signs of peritonitis with convulsions and stupor.

TREATMENT.—Give an emetic. After it has acted, give white of egg in milk, barley water or thick gruel. Administer stimulants, but avoid fats and oils. When relief has been obtained, give a prolonged warm bath if the patient be not faint.

CHLORAL (Chloral Hydrate, Syrup of Chloral).

SYMPTOMS.—Lividity of the face, skin cold; subnormal temperature; respiration and pulse slow; coma.

TREATMENT.—Give an emetic, apply warmth and friction to the body, administer hot coffee and stimulants. Perform artificial respiration, and give oxygen inhalations.

CHLORINE GAS (in Chloride of Lime).

SYMPTOMS.—Irritation of the throat with cough, difficult breathing, tightness of the chest and inability to swallow.

TREATMENT.—Get the patient into the open air, and make him inhale very weak ammonia.

CHLOROFORM (INHALED).

SYMPTOMS.—There is failure of respiration or of the heart's action, or of both. Lividity of face.

TREATMENT.—Have the windows widely opened; clear the mouth and throat, lower the head, pull forward the tongue and keep it out of the mouth, loosen the clothing, perform artificial respiration, flap chest and face with a wet towel, apply repeatedly hot towels to heart region. Inject diluted brandy into the bowel.

CHLOROFORM (SWALLOWED).

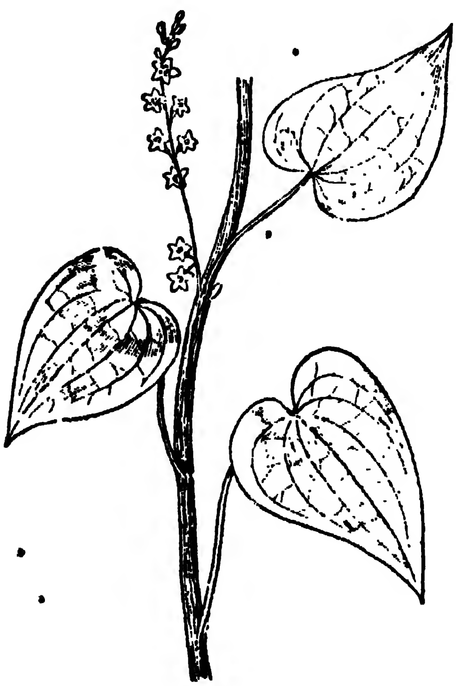
SYMPTOMS.—The breath is redolent of chloroform; a staggering gait is followed by insensibility; pupils widely dilated; breathing stertorous; the pulse is hardly to be felt and the surface is cold.

Treatment.—Give an emetic; after it has acted, give a solution of bicarbonate of sodium in warm water (two teaspoonfuls in half a tumblerful of water). Keep the patient roused; apply a mustard leaf to the heart area; rub dry mustard on the calves of the legs. Inject a pint of hot, strong coffee into the bowel. Hold a (broken) capsule of nitrate of amyl to the nostrils frequently. Do not leave the patient for some hours for fear of a relapse.

Cocaine.—Even one-sixth of a grain injected under the skin may induce toxic symptoms. The addition of adrenalin to less toxic forms of cocain (novocain, etc.), has enabled dentists to employ it for extractions with almost absolute safety. The adrenalin localises its action.

Symptoms.—Pallor; lividity of the surface; hallucinations of sight and hearing; delirium; giddiness and fainting; tremors and convulsions (the latter dangerous if they involve the diaphragm); nausea; dilatation of the pupil; collapse.

Treatment.- Maintain recumbency; give stimulants freely; swab the chest and face with a wet towel; vigorous friction of the entire body and artificial respiration.



BLACK BRYONY
A poisonous plant common in our hedgerows.

Hemlock.—With Conium (Common or Spotted Hemlock) the leaves, seeds, and roots have poisonous properties. This plant has been mistaken for parsley. The Water-hemlock or Cowbane, mistaken for parsnips, has caused death. The Hemlock Water - dropwort, growing on river-banks and in ditches, is very poisonous. The Fool's Parsley or Lesser Hemlock has a great resemblance to parsley and has often been gathered by mistake. Its leaves and roots are very poisonous.

GARDEN NIGHTSHADE
One of the belladonnas—the leaves, berries, and roots of which are poisonous.

Symptoms.—Motor paralysis in the shape of weakness of the limbs and staggering gait, loss of power of swallowing and paralysis of the muscles of respiration, with asphyxia; pupils dilated and fixed; consciousness preserved. In some instances there have been stupor, coma, and slight convulsions.

Treatment.—Emetics, warmth and stimulants and artificial respiration.

Copper, as Verdigris (subacetate) or Bluestone (sulphate).

Bluestone has often been taken with suicidal intent, and administered in homicidal attempts. Fortunately, the taste is strongly metallic and so warning is given. Both it and verdigris cause vomiting which may save the patient.

Symptoms.—Vomiting; a sense of constriction of the throat and gullet; griping; purging; difficulty of breathing; salivation;

MUSHROOM OR TOADSTOOL ?—I.
The very dangerous Death Cap fungus (*Amonita phalloides*)

giddiness, headache, delirium and convulsions ; rapid pulse ; coma (finally).

TREATMENT.—If no spontaneous vomiting, give an emetic after having administered large quantities of milk and egg-white. Now give in half a tumblerful of water one drachm of potassium ferrocyanide, and repeat this dose, if necessary. Give demulcents (barley water, linseed tea, gruel), and apply linseed-meal poultices to the abdomen.

CROTON OIL, CASTOR OIL SEEDS AND VIOLENT PURGATIVES.

SYMPTOMS.—Gastro-intestinal irritation, followed by collapse ; colic, vomiting, purging, pallor of face, features pinched, perspiration, pulse thready, urine diminished or suppressed ; may be delirium.

TREATMENT.—Emetic, followed by stimulants. Then give demulcents (white of egg in milk, barley-water, etc.), and apply linseed-meal poultices to the abdomen.

DIGITALIS (FOXGLOVE).—All parts of the plant are poisonous.

SYMPTOMS.—Abdominal pain ; green vomiting ; purging ; headache ; delirium ; convulsions ; coma ; slow, small and irregular pulse ; dilated, fixed pupils ; skin cold, pale and sweaty ; suppression of urine.

TREATMENT.—*Maintenance of the recumbent position is essential.* Give an emetic, followed, after vomiting by tannin, 10 grains in 2 oz. of water every half-hour for four doses. Then give stimulants and apply warmth to the extremities.

ERGOT OF RYE.

SYMPTOMS.—Cramp; tingling of the limbs; giddiness; weakness; diarrhœa and vomiting.

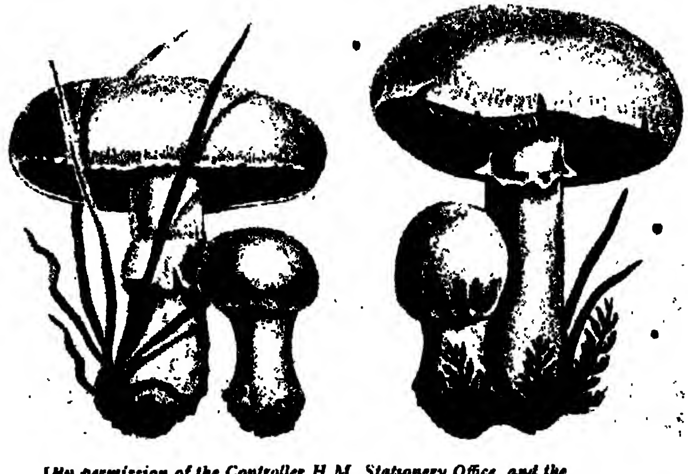
TREATMENT.—Emetic, followed by 1 oz. of castor oil or ½ oz. of Epsom salts ; stimulants ; keep the patient recumbent ; warmth to the extremities.

ETHER (inhaled or swallowed).

SYMPTOMS.—Like those of Chloroform (inhaled or swallowed).

TREATMENT.—The same as for Chloroform (inhaled).

FUNGI (poisonous Mushroom, Fly Fungus).—The Fly-Fungus (*Amonita muscaria*) is one of the most poisonous in this country. When boiled in water, it yields a solution poisonous to animals, and hence is used as a fly-poison. The greatest number of fatalities are, however, caused by the *Agaricus phalloides.* This resembles in appearance the



[By permission of the Controller H.M. Stationery Office, and the Ministry of Agriculture and Fisheries.

MUSHROOM OR TOADSTOOL ?—II.
Left—The edible Common Mushroom (*Psaliota campestris*).
Right—The edible Horse Mushroom (*Psaliota arvensis*).

edible mushrooms, has no unpleasant flavour or odour, and gives rise to symptoms several hours after ingestion, its action being upon the blood, not as a direct irritant. The *Agaricus muscarius*, containing the poisonous alkaloid muscarine, though less poisonous, is, nevertheless, dangerous.

SYMPTOMS.—If they act as narcotics, the meal is soon followed by giddiness, dimness of sight and weakness; the patient appears to be intoxicated, and there are hallucinations of sight. Spasms and convulsions may precede a fatal termination. If the symptoms are deferred to several hours after the meal, there is vomiting, abdominal pain and purging, collapse, excitement and then coma.

TREATMENT.—Emetics, followed by a dose of castor oil; then stimulants and strong tea, warmth to the extremities, with hot poultices to the abdomen.

HOLLY BERRIES.

SYMPTOMS.—Vomiting, headache, abdominal pain and purging; drowsiness, unconsciousness and collapse; contracted pupils; weak pulse.

TREATMENT.—Emetics, followed by stimulants; then a dose of castor oil and warmth to the extremities.

HYOSCYAMUS (HENBANE).

SYMPTOMS.—Almost identical with those present in poisoning by Belladonna (dry mouth, dilated pupils, delirium, etc.).

TREATMENT.—The same as for poisoning by Belladonna.

IODINE, IODIDES AND IODOFORM.—When a poisonous dose of iodine has been taken, the SYMPTOMS are: pain, with hot feeling in the throat and stomach; vomiting and purging, the vomited matters being yellow (or blue, if starchy food be in the stomach); intense thirst; giddiness, faintness and convulsions.

Large doses of the iodides cause the same symptoms. If the poisoning be chronic, iodism' is shown by headache (frontal), watering of eyes and nose, salivation and inflammation of the fauces or larynx.

Poisoning by iodoform is shown by giddiness, purging and vomiting, drowsiness, dilated pupils, hallucinations and nocturnal delirium.

TREATMENT.—If a large dose has been swallowed, give an emetic, followed, after vomiting, by 2 drachms of bicarbonate of soda in a wineglassful of water. If the poison be iodine, give large doses of starch in cold water. Then give demulcents such as milk and eggs or milk and flour boiled with water.

LABURNUM.—Its alkaloid, Cytisine, is said to be present in Australian or Persian Insect-Powder.

SYMPTOMS.—Vomiting and purging; drowsiness, unconsciousness and convulsions.

TREATMENT.—Emetics followed by stimulants, alternate hot and cold douches to the chest and the head, with friction of the extremities towards the heart.

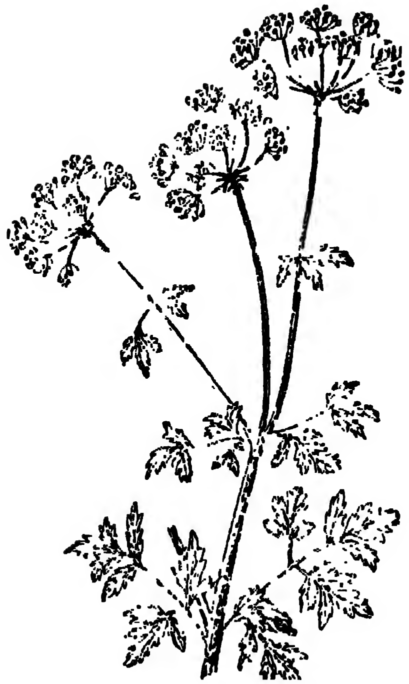
LEAD—as Sugar of Lead (acetate), Goulard's Lotion (subacetate), White Lead (carbonate), lead paint; also in hair-dyes, cosmetics (largely used by actors) and in glazed white leather-lining of hats (dissolved by the sweat).

SYMPTOMS.—Dryness of the throat with metallic taste and thirst; abdominal colic, eased by pressure; constipation; cold sweats; cramp of calves; giddiness; stupor and convulsions.

TREATMENT.—Emetic, followed, after vomiting, by Epsom salts ½ oz. in a tumblerful of water, or 30 drops of dilute sulphuric acid (*not* the strong acid) in the same amount of water. These two latter remedies act as neutralisers of the lead, in that they form the insoluble sulphate. Afterwards give demulcents such as milk, white of egg, barley water, etc., and treat shock.

MERCURY—as Corrosive Sublimate (Perchloride), White and Red Precipitate, Red Oxide, or the acid Nitrate of Mercury.

SYMPTOMS.—If corrosive preparations such as corrosive sublimate or the acid nitrate be taken, the mouth and lips will be swollen and white, the tongue shrunk and also white, and the throat constricted. In all cases there is a metallic taste, stomach pains, nausea, vomiting of mucus and blood, violent purging (bloody stools), cold skin, difficulty



THE POISONOUS HEMLOCKS—I.
The Common Hemlock, all parts of which are poisonous.

of breathing, suppression of urine, fainting and convulsions.

TREATMENT.—Give first of all large quantities of white of egg mixed with milk and water. This is far superior to flour or arrow-root and water often recommended. Then give an emetic, followed, after vomiting, by demulcents and stimulants if much depression. To overcome the suppression of urine, apply hot compresses to the loins.

MUSSELS AND PTOMAINES (animal alkaloids, poisonous fish and meat).

SYMPTOMS.—Vomiting; purging; colic; headache; muscular weakness; quick pulse; rise of temperature; collapse.

TREATMENT.—Emetic, followed, after vomiting, by three tablespoonfuls (for adult) of castor oil. Afterwards, stimulants. Combat collapse by external warmth.

NITRO-BENZENE (Nitro-Benzol, Oil of Mirbane). Present in cheap perfumery, in sweetmeats, and in some boot-blacking. Much used in the preparation of aniline colours.

SYMPTOMS.—Debility; nausea; lividity of surface of body; pupils dilated; convulsions.

TREATMENT.—Emetics, followed by free stimulation (brandy, whisky, sal volatile), alternate hot and cold douches, artificial respiration.

NUX VOMICA (St. Ignatius' Bean) and its alkaloid, **STRYCHNINE**. Strychnia or strychnine is contained in the following vermin-killers: Butler's, Gibson's, Hunter's, and Wiggins'.

SYMPTOMS.—(1) Suffocating feeling; face livid. (2) Rigid convulsions, repeated at short intervals; these cause sweating and exhaustion, backward arching of the spine, the so-called sardonic grin (risus sardonicus), staring eyeballs, fixity of chest and of abdominal muscles. (3) Consciousness retained with hyperacuity of sight and hearing. A distinguishing feature from lock-jaw (tetanus) is that in strychnine poisoning, the muscles of the jaw are affected late, whereas, in tetanus, it is an early symptom. Death in strychnine poisoning is usually due to asphyxia or collapse.

TREATMENT.—(1) Give an emetic. (2) tannin, 30 grains in 2 oz. of water, or tincture of iodine, 30 drops in half a tumblerful of water. Follow this up with another emetic. Later, perform artificial respiration, if feasible.

OPIUM (and its alkaloids, Morphine, Codein, etc.), as in Laudanum (tincture of opium), Paregoric, Dover's Powder, Black Drop, Battley's Sedative Solution, Godfrey's Cordial, Dalby's Carminative, Chlorodyne, Nepenthe, Winslow's Soothing Syrup, Syrup of Poppies.

SYMPTOMS.—After a period of mental excitement: (1) Headache, weariness, drowsiness; (2) Lessening of sensibility; (3) Pupils contracted to "pin-point" and soon fixed; (4) Blueness of face, skin cold; (5) Relaxation of muscles; (6) Slowness of respiration, stertor; (7) Coma.

TREATMENT.—(1) Emetic (emetics act badly in these cases; the best is mustard). (2) Give hot strong coffee (1 pint). (3) Permanganate of potassium, 10 grains in half a tumblerful of water. (4) Rouse patient by movement, dashing cold water in his face, etc. (5) If somnolence gains ground,

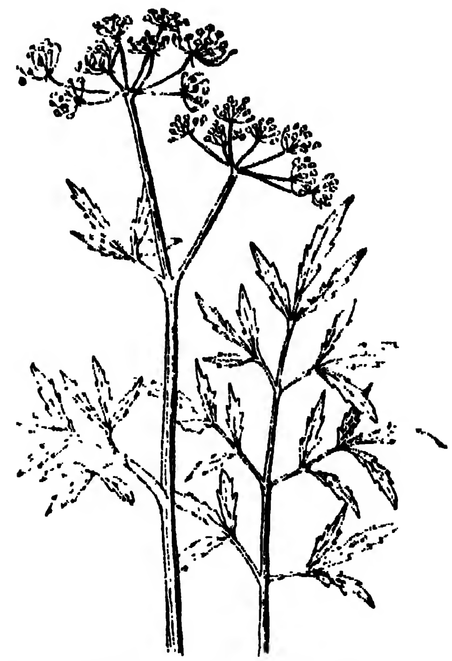
perform artificial respiration and apply warmth to the extremities.

The danger in opium poisoning is failure of the respiratory centre. This is why the patient must be roused at all costs ; do not, however, exhaust him by too much movement. When improvement is decided, let him sleep, but watch him for fear the breathing stops, when artificial respiration plus oxygen inhalations are indicated. The heart may also fail after apparent recovery. Watch the pulse. *Never give alcoholic stimulants* in these cases.

PARAFFIN, PETROLEUM, OR PETROL.

SYMPTOMS. (1) Burning pain in alimentary tract. (2) Vomiting of matter smelling of and looking like paraffin. (3) Thirst, restlessness. (4) Odour of oil in breath. (5) Feeble respiration. (6) Signs of collapse. (7) Coma.

TREATMENT.—Emetic followed by stimulants, warmth and friction.



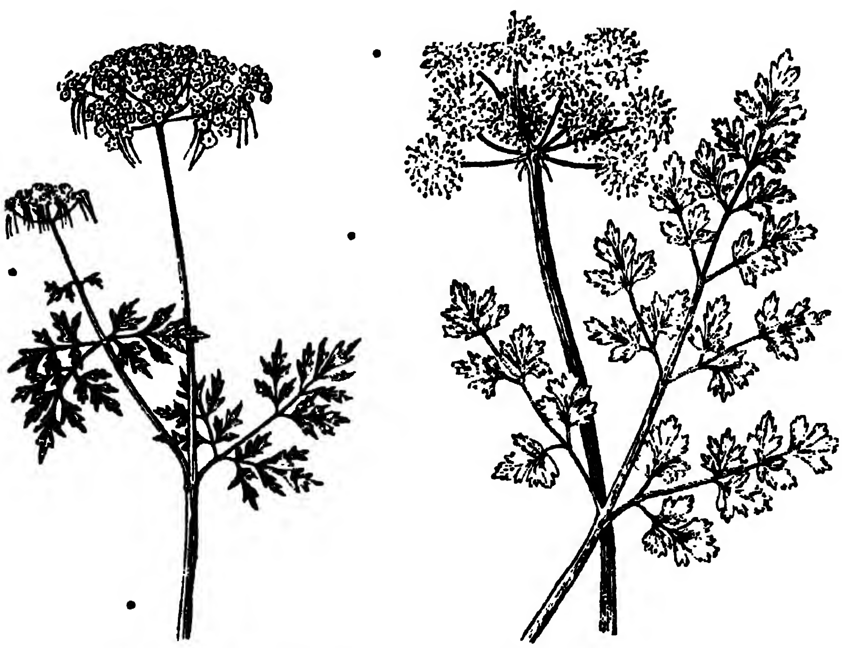
THE POISONOUS HEMLOCKS—II.
The Water-Hemlock or Cowbane, sometimes mistaken for parsnips.

PHOSPHORUS, as in lucifer matches (only those made of yellow phosphorus, those made of red phosphorus being insoluble and innocuous), rat poison, vermin killer.

SYMPTOMS.—When these occur early—a few hours after swallowing the poison, they are : (1) A taste of garlic. (1) A burning pain in throat and abdominal swelling with (green or black) vomiting of blood. The vomit has odour of garlic and is phosphorescent (luminous) in the dark. The urine is scanty and may contain blood.

If the patient does not die, there may be an intermission of a few days (no fresh symptoms), but this may be followed by jaundice, enlargement of the liver, great debility and finally coma.

TREATMENT.—(1) Emetic, preferably sulphate of copper, 3 grains in 4 oz. of water every five minutes until vomiting occurs, then every half-hour for four doses. The copper salt acts, not only as an emetic, but as an antidote (neutraliser). (2) After



THE POISONOUS HEMLOCKS—III.
***Left*—The Lesser Hemlock or Fool's Parsley, very similar to the edible parsley. *Right*—The Hemlock Water-Dropwort, a very poisonous variety found along ditches and river-banks.**

free vomiting, give old or French turpentine, 40 drops in 1 oz. of water every 15 minutes, for one hour, then thrice daily. *Do not give American or German turpentine.* (3) Give ½ oz. Epsom salts in half a tumblerful of water. (4) *Avoid all oils and fats.*

TOBACCO and its alkaloid **NICOTINE.** Also contained in some insecticides.

SYMPTOMS. The action of nicotine on the heart is as follows: It first slows the beats by stimulating the pneumogastric (vagus) nerve; this nerve then becomes exhausted and the sympathetic then takes the predominance and the beats are quickened. This leads to exhaustion of the heart-muscle. The symptoms appear in the following order: (1) Burning acrid sensation in mouth and throat. (2) Depression, giddiness, nausea, vomiting, coldness of the body surface, with clammy sweat. (3) Unconsciousness, with feeble breathing. (4) Coma.

TREATMENT.—(1) Emetic; (2) Stimulants and warmth to the extremities. (3) Artificial respiration. (4) Keep the patient lying down.

TURPENTINE (Oil and Spirits of Turpentine, Turps and Camphene).

These cases are rare and have occurred chiefly in children. The symptoms resemble somewhat those of opium poisoning.

SYMPTOMS.—(1) Odour of turpentine in the breath. (2) Breathing stertorous. (3) Pupils contracted. (4) Convulsions and coma. (5) Bladder irritation, urine smelling like violets.

TREATMENT.(1) Emetic followed by (in adult) Epsom salts, ½ oz. in half a tumblerful of water. Give a child a smaller dose. (2) Demulcents.

VERONAL (taken, commonly, for insomnia).

SYMPTOMS.—Somnolence; unconsciousness; cyanosis (blueness); cold extremities; coma.

TREATMENT.—Emetic, 1 pint of hot strong coffee with 1 oz. of castor oil. If unable to swallow, inject into the bowel.

ZINC as Sulphate (White Vitriol) and Chloride (Burnett's Disinfecting Fluid).

SYMPTOMS.—(1) Corrosion of lips and mouth. (2) Pain in throat and stomach, with difficulty in swallowing. (3) Blood-stained vomiting. (4) Rapid pulse and breathing. (5) Convulsions, paralysis and coma.

TREATMENT.—*Do not give an emetic.* (1) Give large draughts of egg-white and milk. (2) Large quantities of bicarbonate of sodium in warm water (1 teaspoonful in half a tumblerful of water, and repeat).

RECOGNITION OF THE POISON TAKEN

The prompt recognition in a case of poisoning of the drug that has been swallowed or breathed is not always easy even for the doctor. A few deductions drawn from the circumstances observed by the First-Aider and from the nature of the symptoms will prove useful as guides to a correct conclusion.

The following poisons are frequently taken with suicidal intent:—

Opium and its various preparations (commonest of all poisons); Oxalic acid; Rat Paste or Vermin Killer (Strychnine, Arsenic or Phosphorus); Prussic Acid or Cyanide of Potassium; Chloral; Sugar of Lead (acetate); Strychnine; Carbolic Acid.

The following poisons are usually taken unintentionally:

Patent medicines of all kinds; Carbolic Acid; Poisonous Plants and Mushrooms; Indigenous Poisonous Plants*; Woody, Garden and Deadly Nightshade (all containing Belladonna); Aconite, Monkshood, Wolf's-bane or Blue Rocket (Aconitum Napellus); Foxglove (Digitalis Purpurea); Spotted Hemlock (Conium Maculatum); Arum (Arum Maculatum); Colchicum (Colchicum Autumnale); Bryony (Bryonia Dioica); Henbane (Hyoscyamus Niger); Fly Agaric (Amonita Muscaria); Mezereon or Spurge Olive (Daphne Mezereum); Laburnum (Cytisus Laburnum). Most of these plants have been mentioned in the preceding pages treating of poisons.

The patient is dead on your arrival. A huge dose of any active poisonous drug may,

* From Murrell's *What to do in Cases of Poisoning.*

of course, prove quickly fatal. The more probable hypothesis is, however, that a quickly acting drug has been absorbed. Of such drugs, think of Prussic Acid (or Cyanide of Potassium); either of these may kill in a few minutes. Other quickly acting drugs are Oxalic Acid; Strong Ammonia; Carbonic Oxide; Carbonic Acid.

The patient is in a state of coma.—This at once suggests Opium or its preparations; a large dose of Alcohol; Chloral; Chloroform; Camphor.

The patient is collapsed.—The reader will have noticed that most poisons induce collapse after an interval more or less prolonged. The lethal agents he should think of more particularly are: Alkalies; Strong Acids; Aconite; Antimony; Arsenic; Tobacco.

The patient is wandering (delirious). Think of Belladonna; Hyoscyamus (Henbane); Stramonium; Cannabis Indica (Indian Hemp); Alcohol; Camphor.

The patient's muscles are tetanised (contracted). This should suggest at once Strychnine or Nux Vomica.

The patient has convulsions.—No useful deductions to be drawn.

The patient is paralysed.—Think of Conium (Hemlock); Aconite.

There is dilatation of the pupils.—Belladonna or its alkaloid, Atropine; Aconite; Conium; Alcohol; Chloroform.

There is contraction of the pupils.—Opium ("pin-point" pupils); Physostigmine; Chloral.

There is a dry skin.—Belladonna or Atropine; Hyoscyamus (Henbane); Stramonium.

There is a skin-rash.—Belladonna or Atropine (like that of Scarlet Fever); Stramonium (a similar rash); Antipyrine.

A peculiar odour of the breath is perceived.—Prussic Acid; Alcohol; Carbolic Acid; Ammonia; Chloroform; Iodine; Phosphorus; Camphor; Nitro-benzene. Do not forget that Laudanum (Tincture of Opium) is often taken in stout.

The mouth is bleached.—Think of the Corrosives.

The mouth, tongue and lips are numb.—Aconite.

There is vomiting. Arsenic; Antimony; Digitalis (Foxglove); (vomit is grass-green) Aconite; Phosphorus (vomit is luminous in the dark).

There is purging.—Irritant poisons or Violent Purgatives.

There is colic. Lead (pain around navel and relieved by pressure); Copper; Arsenic; Colocynth.

There is cramp. Lead; Arsenic; Antimony.

The drug was inhaled. Ammonia; Ether or Chloroform; Benzine; Carbonic Acid Gas; Carbonic Oxide Gas; Coal Gas; Sewer or Cesspool Gas; Cellar, Well, or Mine Gas (choke-damp).

UNCONSCIOUSNESS

THE First-Aider will, certainly, in the course of his ministrations, have to deal with cases of unconsciousness; it therefore behoves him to acquire some knowledge of the possible causes of this condition.

These are: Asphyxia; Cranial Injury; Cerebral Hæmorrhage (Apoplexy); the formation of a clot in the blood-vessels of the brain (Thrombosis); the migration of a blood-clot or a fragment of a diseased heart-valve to the brain (Embolism); Diabetes; Epilepsy; Uræmia; Poisons, particularly opium and alcohol; Fainting; Heat-stroke; Infantile Convulsions (this and Epilepsy will be discussed under the heading "Fits").

Diagnosis.

If a HISTORY of the unconscious person from a friend or acquaintance be procurable, it is to be eagerly welcomed; you may be told that the patient is subject to epileptic fits; that he is under treatment for diabetes or for Bright's disease of the kidneys; that he has lately complained of headache or that he has had previous attacks of insensibility.

[Sport and General

AN AMBULANCE MAN AT WORK

A spectator collapses at a crowded football match. Over-crowding and long-standing are common causes of fainting fits.

The MODE OF ONSET of the attack should be ascertained—whether it was sudden, as in apoplexy, or gradual, as in diabetic coma.

Frequently, however, no such information is forthcoming. In this case the First-Aider must exercise his common sense based upon his knowledge and experience. He must, first of all, carefully seek for SIGNS OF INJURY, especially of the skull.

He should note the general physical appearance and build of the patient. A stout, congested individual, with a suffused countenance, breathing noisily (stertorously) suggests cerebral hæmorrhage. If he has a wasted, emaciated frame, he is more likely to be suffering from diabetic coma. If he foams at the mouth and the foam is blood-stained from a bitten tongue, and the contents of the bladder or bowel are passed, he is probably an epileptic.

Find out if the coma is complete or only partial. Note if there be any response to shouting, pinching, or the presentation of smelling salts to the nostrils. Notice the quality of the breathing, whether noisy and stertorous as in apoplexy; slow, almost inaudible, as in opium poisoning; slow, feeble and often irregular as in fainting; or deep and sighing, as in diabetic coma.

Smell the breath. Never forget, however, that unless you are the first on the scene, brandy or whisky will, almost certainly, have been poured into the patient's mouth by bystanders. Then, again, laudanum (tincture of opium) is often, in cases of suicide, taken in stout, although the characteristic odour of laudanum can be detected by one familiar with it. The breath in diabetic coma has a quite distinctive odour (of acetone), resembling that of apples. In uræmic

coma (a complication of Bright's disease), the breath often has a urinous odour.

The bodily temperature is rarely helpful. In one instance, however, its marked elevation distinguishes a case of pontine hæmorrhage (rupture of an artery in that part of the brain called the pons varolii) from opium poisoning, in which no such rise occurs. In both these conditions, the pupils are greatly contracted. In heat-stroke, the body-temperature may also be very high.

Pick up the arms and legs, and let them fall. If the limbs on one side fall more "dead" than do those on the other side, there is paralysis from some local pressure or destruction in the brain (hæmorrhage, thrombosis or embolus). In such a case, the mouth will be drawn towards the healthy side and the cheek on the paralysed side will flap loosely in breathing. Here the *age* will be of help. In an elderly man, the cause is most likely to be hæmorrhage; in a young man, disease of the arteries of the brain from syphilis; in a child, embolism (a clot or fragment of a diseased heart-valve detached and carried by the blood-current to the brain).

The pupils of both eyes may be dilated. This is the case in the coma following an epileptic fit, in uræmic coma and in general compression of the brain. It is the most usual condition in deep coma.

Bilateral contraction of the pupils is seen in opium poisoning and in hæmorrhage into the pons varolii.

Squint is strongly suggestive of meningitis (inflammation of the brain-membranes). If blood be seen in the passage of one of the ears, it may be evidence of a fracture of the base of the skull.

The various conditions causing insensibility will now be discussed in detail and the appropriate immediate treatment indicated.

Fainting.

1. Fainting (Syncope) is due to a deficient supply of blood to the brain. This induces a temporary loss of consciousness. In the majority of cases of fainting, the "fit" is of a transient character, lasting hardly one minute; in some instances, however, *e.g.* when the heart is diseased or after a severe hæmorrhage, it may have a much longer duration.

The CAUSES are numerous. Some persons faint from slight causes—strong emotion, fright, bad or good news, overwhelming joy, disgust excited by a disagreeable odour, foul heated air, the sight of blood or of an accident. The exciting causes may, again, be a blow on the abdomen or on the head, acute pain (as in renal or biliary colic, both being from the passage of a stone), a sudden resumption of the standing posture, especially when the heart is not in a healthy state. Serious syncope may follow the action of a strong purgative in a delicate woman. Unwonted exertion, such as running to catch a train, will, especially in persons no longer young, sometimes occasion an attack of fainting. This same elderly person may bring on an attack by getting out of bed suddenly, more especially if a distended bladder be as suddenly emptied. A debilitating illness favours syncope, if, during convalescence, an abrupt resumption of the erect posture be made, even in bed. A profuse hæmorrhage followed by shock, fatty degeneration of the heart-muscle, a previous attack of diphtheria are sometimes the forerunners of the most dangerous fainting fits. The attacks arising from these various causes should serve as a warning to the victims. They should avoid heated, ill-ventilated rooms, very hot baths, tightness of clothing, prolonged fasts, unusual exertions and excessive smoking, especially in crowded smoking rooms.

A fainting fit in a person whose heart is diseased may prove quickly fatal. The majority of such attacks are, however, soon recovered from. There may be warning SYMPTOMS such as dizziness, dimness of sight and hardness of hearing, and a sinking feeling. Then the patient is seen to become very pale, cold drops of sweat may appear on the hands and face, and he sinks unconscious. Should this condition last more than a few seconds, a serious cause may be at the bottom of it and a doctor should be summoned.

First-Aid Treatment.—A threatened fainting fit should be thus treated: Get the patient quickly into the open air or near an open window, lay him down with his *head lower than the body*, loosen all constrictive clothing and give him a teaspoonful of sal volatile in a wineglassful of water. When the fainting is complete, carry him with his *head low* to the open air, loosen his clothing, dash cold water on the face and hands, hold smelling salts to the nostrils, keeping his head always lower than the body. *When consciousness returns* (not before) give sal volatile or a hot drink. If the stimulant be poured into the mouth before the return of consciousness, the First-Aider may find that he has been dealing with a case of cerebral hæmorrhage and not with one of syncope. This stimulating treatment would then be wrong.

If the fainting be prolonged, and the doctor have not arrived, the limbs should be massaged in the direction of the venous flow, *i.e.* towards the heart. Should unconsciousness be further prolonged, apply a mustard leaf over the heart region (avoiding the nipple), a covered hot-water bottle to the feet, and perform artificial respiration.

2. Asphyxia has already been fully dealt with (see page 1151).

3. A distinction must be made between shock and collapse. In both there is great nervous depression and weakness, which may bring the sufferer very near death. When this condition appears suddenly after an operation or a bad injury, it is called shock; when it appears gradually in the course of an exhausting disease, it is called collapse. One of the causes of profound shock is extensive burns, especially of the abdomen and of the perineum (the fork). The condition results from the exhaustion of the vaso-motor centre in the medulla oblongata, the function of which nerve-centre it is to maintain the normal calibre of the arteries and thus keep up blood-pressure. The arteries dilate, the blood collects in the abdominal vessels, and the brain becomes anæmic. Another cause of shock is seen in railway smashes, the injuries being crushing or laceration of the limbs, etc. Finally, a fruitful cause is an injury involving the abdominal organs and loss of blood. Collapse is seen in the final stages of conditions such as peritonitis, cholera, bowel obstruction, typhoid fever, etc.

Shock and Collapse.

The symptoms show the face pallid and shrunken, the skin cold and clammy, the breathing shallow and slow, and the pulse small and weak. The temperature is subnormal (below 98.4°F.), the eyes are sunken and pupils dilated; there is great thirst. Recovery is shown by a return of colour to the surface, a rise of temperature, stronger pulse, and, sometimes, vomiting.

TREATING A CASE OF FAINTING

Fresh air is the first essential; all tight clothing should be loosened and the patient's head placed lower than his body.

[Photopress

TREATING "VICTIMS" OF A RAILWAY "SMASH"
A demonstration by railway ambulance men, including treatment for the severe shock which accompanies such disasters.

First-Aid Treatment.—Keep the patient lying down *indoors* and *in bed*, surround him with hot-water bottles (to feet, armpits, inside of thighs) and hot blankets. See that the bottles are adequately protected by flannel covers. Raise the foot of the bed on blocks so as to favour the brain circulation. Give *sweetened* hot coffee, but *avoid alcoholic stimulants.* In very severe cases, apply flannel roller bandages, not too tightly, from the toes and the fingers up to the roots of the limbs, so as to confine the blood to the anæmic brain. Should the breathing become enfeebled, perform artificial respiration.

Concussion of the Brain.

4. Concussion of the Brain is a condition resulting from a shaking or bruising of the brain after a blow or fall on the head, or a fall from a height on the feet or on the buttocks.

The severity of the symptoms depends upon the greater or less violence inflicted. They may vary from a slight momentary giddiness and confusion of thought to complete insensibility. The condition is closely allied to shock; indeed, there may be some difficulty in distinguishing the one from the other. In a well-marked case, there is more or less complete unconsciousness, but the patient can sometimes be roused by shouting. He lies on his back with his muscles relaxed; the eyelids are closed and insensitive to touch; the pupils are generally equal and often contracted, and they react to light. In severe cases, they are dilated and fixed (do not react to light). The body-surface is cold and clammy, the respirations shallow, sighing and slow, the pulse rapid, weak, and nearly impalpable; the temperature is at first subnormal; there may be unconscious evacuations from the bowel and bladder.

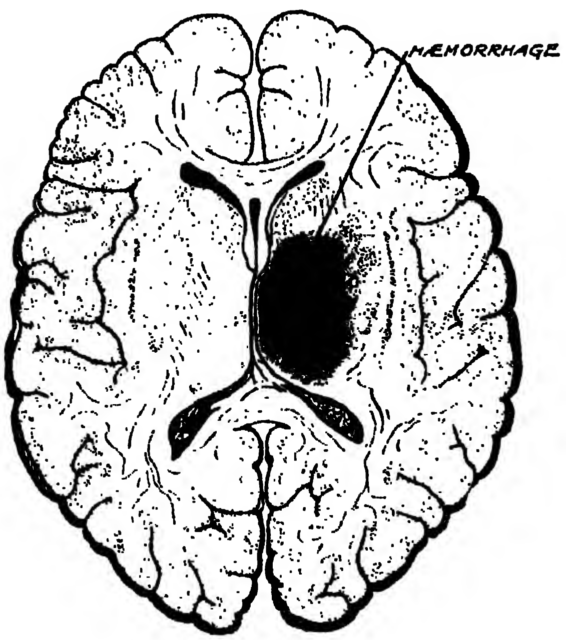
This condition, after lasting a considerable time, may change to one of deeper unconsciousness and death, or there may follow the symptoms of inflammation, compression or irritation of the brain. In the milder

cases, reaction sets in. The pulse and breathing improve, consciousness is more or less restored; the patient may be able to give his name and address. The improvement continues, vomiting occurs (this is a good sign) and he may suffer from headache for a few days; there may be a rise of temperature. Complete recovery may follow, but often there are left loss of memory, an irritable temper or defective speech. In the severest cases, all memory of the accident may be lost.

First-Aid Treatment.—This is the same as for shock. Keep the patient *in bed* in a darkened room and very quiet; *avoid stimulants*, unless a fatal termination be apprehended, when brandy in hot coffee may be injected into the bowel. An ice-bag may be applied to the head.

Compression of the Brain.

5. Compression of the Brain is caused by a head injury leading to pressure on the brain from a depressed bone or from a clot of blood either between the skull and the membranes, between the membranes themselves (dura mater, arachnoid and pia mater) or between the innermost membrane and the brain.



A CAUSE OF APOPLEXY
A burst blood-vessel in the brain—the commonest cause of apoplexy or "stroke."

The symptoms are paralysis of one side of the body, profound insensibility with stertorous breathing, unequal pupils, and a full, slow pulse. Where the compression is due to a clot of blood collected between the skull and the dura mater (the outermost membrane), the symptoms may be deferred until some hours after the injury.

First-Aid Treatment.—Dress any scalp wound that may be present, keep the patient quiet in a darkened room, and await the arrival of the doctor. *Give no alcohol.*

Apoplexy.

6. Apoplexy is what is commonly known as a "stroke." It is a loss of consciousness caused by a sudden interruption of the normal circulation in the brain. There are three causes of this condition: (1) the bursting of a blood-vessel in the brain (hæmorrhage); (2) the blocking of a vessel in the brain by a clot or a fragment of a diseased heart-valve (embolism); (3) the gradual formation of a clot in an artery of the brain usually occurring in an old person whose arteries are degenerated (thrombosis). This deprives a certain area of the brain of its supply of blood.

In embolism the onset of symptoms is very sudden and without warning. In thrombosis the onset is gradual. In hæmorrhage, the commonest of all, the onset is sudden, but there may have been warnings such as dizziness, headache, numbness or a weakness of an upper or a lower limb.

The following refers to cerebral hæmorrhage, the commonest. The condition is more frequent in men than in women, and is unusual before middle age is attained. The conditions favouring cerebral hæmorrhage are chronic kidney disease and intemperance in eating and in drinking for many years. Violent exertion, mental excitement or exposure to great heat may, in such a subject, bring on an attack. The stroke may be fatal, or the patient, though always liable to a fresh attack, may recover with one side of the body paralysed, impaired speech and an exaggeration of the emotional side of his personality.

Symptoms.—The patient, with or without warning, suddenly becomes unconscious

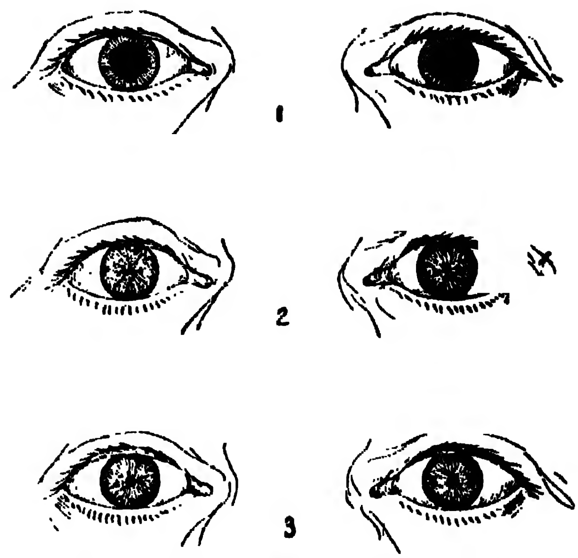
with stertorous breathing, the cheeks being puffed out at each expiration. The state of the pupils enables us to discriminate between drunkenness (the history of the seizure is here also instructive), opium poisoning and apoplexy. In alcoholic intoxication, the pupils are dilated ; in opium poisoning, they are contracted to a " pin-point " size ; in apoplexy, they may be contracted (but not to pin-point size), but they may also be unequal in the two eyes, and they are insensible to light (fixed). To determine this latter point, expose the eye to a bright light. In a normal eye, such an exposure makes the pupil contract ; on the withdrawal of the light, the pupil dilates. In apoplexy, neither the exposure to light nor its withdrawal has any effect on the pupil.

In an apoplectic seizure of this type, the arm and the leg on one side are seen, after being lifted and dropped, to fall helplessly ; this is in marked contrast with the limbs on the other side, which do not drop so " dead." The pulse is slow and the patient cannot be roused from his insensibility.

FIRST-AID TREATMENT.--Loosen all constrictive articles of clothing, especially about the neck. Turn his head to one side ; this makes his breathing less stertorous. *Keep him absolutely still* in that position till the doctor arrives. Remember that bleeding is proceeding and that the quieter the patient is kept the more chance there is of the arrest of the bleeding. It is far better to let him lie in the room where the seizure took place than to remove him up flights of stairs. Do not undress him and do not lift him into bed. The only other service the First-Aider can render is to apply an ice-bag to the head and to remove any false teeth that may be worn.

7. ACUTE ALCOHOLIC POISONING. This subject has already been discussed (see page 1161). Should you hesitate in your diagnosis between this condition and apoplexy, decide in favour of the latter, and *give no emetic nor antidote.*

8. Heat-stroke and Sunstroke are variants of the same condition, the first being the



DIAGNOSIS FROM THE EYE-PUPILS

The eye-pupils are (1) dilated in alcoholic intoxication ; (2) contracted (to " pin-points ") in opium poisoning ; and (3) insensible to light and may be contracted unequally in a case of stroke.

result of prolonged exposure to a high temperature under cover, while the second results from exposure to direct sunlight.

Heat and Sunstroke.

Although of most frequent occurrence in tropical zones, these conditions may arise in temperate climates during hot spells, especially when there is a moist condition of the atmosphere, for this greatly interferes with the cooling of the overheated body. Cases are often observed among soldiers stationed in hot climates when circumstances compel them to live in over-crowded and ill-ventilated barracks. Under similar conditions, sailors and those whose occupations expose them to extremes of heat stokers, engineers and laundry workers are liable to suffer. In the tropics the newly-arrived European is more subject to these ailments than the native, though the latter is not immune.

There are certain influences which predispose to sunstroke and heat-stroke, and included amongst these are general debility, disease of the nervous system, over-work, worry, fatigue, poor nutrition, intemperance, the wearing of tight garments, and living in insanitary surroundings.

In HEAT-STROKE (or HEAT EXHAUSTION) the

[*Sport and General*

OVERCOME BY THE HEAT
Ambulance men attending to a case of sunstroke on a hot day.

A milder form shows itself by abundant sweating, pallor of the skin, blueness of the lips, dilated veins and bloodshot eyes. The patient may become unconscious, but he recovers in the shade.

In other cases, an exhausting march brings on the symptoms such as headache and intolerance of light. This is not so dangerous a form, but the headache may persist for a long time.

onset may be sudden ; sometimes there are warnings such as headache, great thirst, faintness, somnolence, nausea and tingling of the extremities. Prostration follows, with pallor and clamminess of the skin, weakness, sometimes syncope (rare), stomach ache, and inability to retain the urine. In very severe cases there may be convulsions, difficult breathing, blueness of the skin and lips, a high temperature and death from heart-failure.

In SUNSTROKE, there may be warnings such as irritability and a feeling of weakness, with a dry skin and abnormal activity of the kidneys ; or the patient may be dizzy and complain of headache.

The attack may be sudden, a violent headache preceding unconsciousness. In the majority of cases, the seizure is less dramatic. Restlessness, oppression, a flushed face, a hot and dry skin, a rapid pulse and contracted pupils accompany violent headache, cramp in the stomach and frequent passage of urine. The temperature is found to be considerably raised (101°, 102° and upwards to 106°F.). If improvement sets in, the temperature falls in a few days to normal and consciousness returns. In fatal cases, the insensibility deepens.

We sometimes read of a crime committed by a person said to have had sunstroke. This condition, indeed, often leads to increased irritability of temper, loss of memory and great susceptibility to the influence of heat and alcohol. Epileptic seizures may follow an attack of sunstroke.

FIRST-AID TREATMENT.- Remove the patient into the shade and loosen tight clothing, especially about the throat. Souse the face and neck with cold water. When he can swallow, give a teaspoonful of sal volatile in half a tumblerful of cold water, and repeat the dose, if necessary. Should the temperature be raised, swathe him in a wet sheet and rub ice into the scalp. If, however, the skin is cold and the pulse weak, abstain from the wet sheet and apply a mustard plaster to the chest. If the patient's condition threatens collapse, a hot bath is indicated. If the breathing fails, perform artificial respiration.

For a time after sunstroke or heat-stroke, the diet should be composed of milk, beef-tea, junket and such light ingredients. After an attack, hot climates should be banned, and also alcohol. When the patient has recovered his consciousness in an attack, *give no alcohol.*

FITS

EPILEPTIC FITS

EPILEPSY is a disorder of the nervous system of which the distinguishing feature is a sudden and complete loss of consciousness, followed or not followed by convulsions. This definition covers the two main types: viz., (1) Grand mal or True Epilepsy; (2) Petit mal, or Minor Epilepsy.

True Epilepsy (Grand Mal) constitutes what is ordinarily known as epilepsy. It almost invariably begins in late infancy or in childhood; it *very rarely* begins in adult life.

True Epilepsy (Grand Mal).

It is certainly hereditary, that is, the predisposition to the disease can be transmitted by the parent to the child. Neither of the parents may actually suffer from epilepsy; but it suffices that they are victims of kindred mental diseases. Parents who are chronic alcoholics are very liable to generate epileptic children. More than half the cases of epilepsy have had chronic alcoholic parents.

SYMPTOMS. The epileptic may have a warning, called an *aura*, announcing the approaching attack. These warnings include various sensations such as an itching of the arm or the palm of the hand, a feeling of sickness, a heart-fluttering, flashes of light, a ringing in the ears or a particular odour. This warning, becoming well-known to the patient, sometimes gives him time to lie down in a safe place in expectation of a fit. In some patients there is no warning; he falls down with a cry. Even the warning may give no time for lying down, and so serious falls (down the stairs, into the fire, etc.), may be incurred.

The fit is marked by three stages:—

1. In the Rigid Stage, the patient falls down unconscious, often with a peculiar cry. He then becomes rigid, all his muscles being contracted. His teeth are clenched, his head usually turned to one side and drawn back, the hands are clenched with the thumb turned into the palm. During this phase the breath is held. This lasts a few seconds (ten to thirty) and merges into the second stage.

2. In the Convulsive Stage, the rigidity is transformed into violent jerkings of the limbs, of the facial muscles, especially those of the lower jaw. The eyes are rolled, and froth, often tinged with blood from the biting of the tongue, appears between the lips. The blueness of the lips of the first stage, caused by the suspension of the respiration, now gives way to a more natural colour, the breathing having been now resumed. At this stage the contents of the bladder may be passed unconsciously. This stage lasts a minute or a minute and a half, and gives way to the third stage.

3. In the Comatose or Exhaustion Stage the patient is completely unconscious, and this may last several minutes. He may then resume consciousness, but he generally sinks into a profound sleep. The insensibility may, on the other hand, merge into a quiet sleep without any sign of resumption of consciousness. This sleep lasts some hours. He may then wake up quite his natural self or perhaps complaining of headache.

In some instances, no sleep follows the fit, and the whole affair may be over in a few minutes, the patient being, apparently, none the worse for his contortions. Post-epileptic crimes have been committed after the fit, the patient having no recollection of the act committed on emergence from the seizure.

Minor Epilepsy (Petit Mal) is distinguished from the Grand Mal by the absence of convulsions. With or without a warning or *aura*, the patient may suddenly become livid, stare fixedly and show an expressionless face. If he should happen to be speaking or eating he becomes silent in the middle of a phrase or drops his knife and fork. In a few seconds he perhaps resumes consciousness, or goes on with his meal or his conversation as if nothing had occurred. He may, however, commit some eccentricity, such as taking off his boots, yawn or stretch his arm. He may

Minor Epilepsy (Petit Mal).

leave the room abruptly without greeting his companions.

Petit mal may last, as such, for years, but it finally becomes lost in the grand mal.

Jacksonian Epilepsy.

Called after the late Dr. Hughlings Jackson, who first drew attention to it, Jacksonian Epilepsy differs from the preceding forms in that, during an attack, there is no complete unconsciousness, and that the convulsive movements first originate in a particular region such as an arm, leg, or face, and remain thus localised or spread thence to other parts of the body. The patient may retain consciousness all through the seizure, or he may lose consciousness towards the termination of the attack. This form is the result of some local irritation of that part of the cortex of the brain which governs the movements of the muscles first affected during the seizure. It is generally caused by thickening of scar tissue or of bone, the result of a former injury. This presses on the brain and brings on the attack.

Uræmic convulsions and hysteria are the two conditions likely to be confounded with epilepsy. Remember that epilepsy beginning in adult life is very rare, and that while the bladder is frequently emptied unconsciously during the epileptic fit, this does not happen in an hysterical seizure. In hysteria also, unconsciousness may not be complete, and your utterances may be remembered after the fit is over. Uræmic convulsions will have to be diagnosed by the doctor.

First-Aid Treatment of Epilepsy.—All that can be done is to prevent the patient injuring himself during the fit. Nothing that the First-Aider can do will arrest the seizure. The tongue can be protected from a bite by the insertion of a slip of wood between the back teeth (maintain your hold on the wood till the fit is over). Let the patient sleep after the fit. Should he complain of headache, apply an ice-bag to the head and allow him to sleep.

For the relation existing between Epilepsy and Mental Disease—see Section on "The Mind."

HYSTERICAL FITS

Hysteria is defined as an unstable condition of the nervous system not caused by any organic disease. It is commonest amongst Jews and far more common in the Latin races (French, Italians and Spaniards) than in the Anglo-Saxons. It is said to occur twenty or twenty-five times more frequently in women than in men in this country. In France, men are much more frequently the subjects of its manifestations. The horrors of the Great War, however, evoked a good deal of hysteria lying latent in our soldiers.

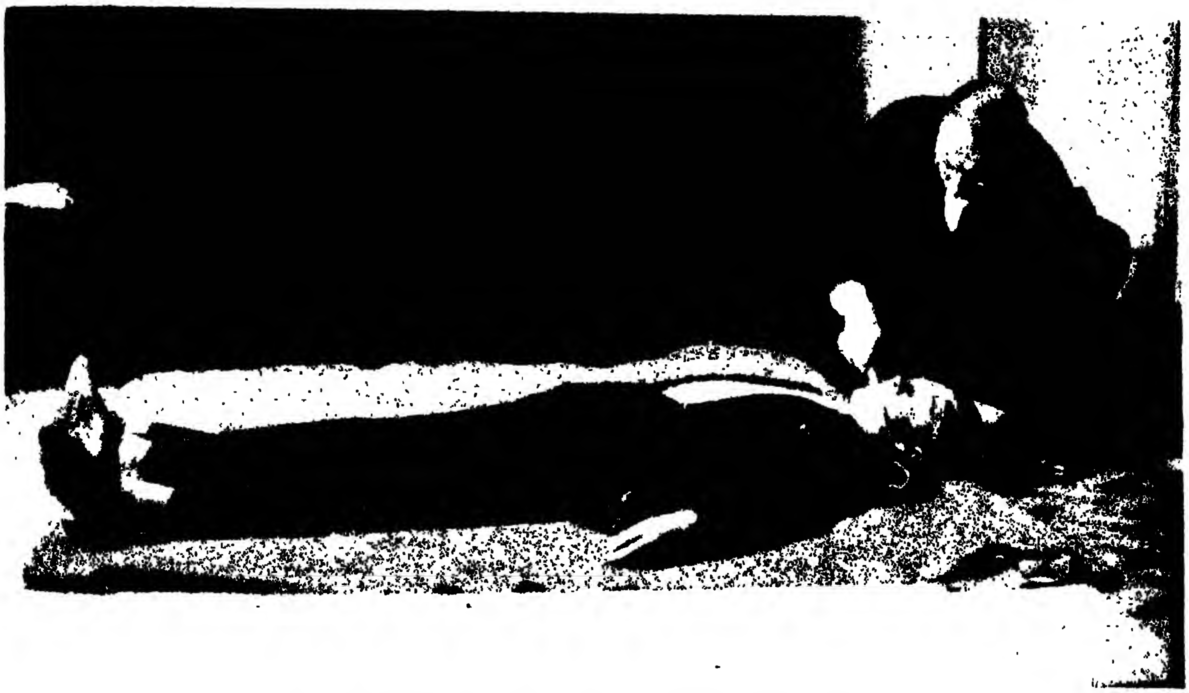
It is important to know that a good many women are distinctly hysterical without having any fits. Hysteria may manifest its presence in many ways; it may mimic almost any disease.

Three stages are described :—

1. In the First Stage, warning symptoms, such as depression, irritability or restlessness may be present. The patient is, evidently, "not herself." She may have a pain on the top of the head which she describes as like that produced were a nail driven into her skull. There may be, also, great tenderness of the breasts or in the lower part of the abdomen on each side. She may also complain of giddiness and noises in the ears.

A frequent symptom is a sensation as if a ball were rising in the throat (globus hystericus). This is caused by spasm of the constrictor muscles of the gullet. The patient may also first laugh and then cry and continue to act thus until the second stage.

2. The Second State is the convulsive fit, which the inexperienced may mistake for an epileptic seizure. When it assumes the epileptiform character, the patient utters a shriek, falls, and, once on the ground, throws her limbs about. Unlike the genuine epileptic, she carefully selects a soft spot to fall upon and thus avoids hurting herself. Another distinction is that she usually selects a time for her fall when witnesses are present. She twists her mouth in all directions, rolls her eyes about, grinds her teeth, and sometimes foams at the mouth. The fit is more dramatic than the epileptic seizure, and is inspired by an evident desire to excite



PROTECTING AN EPILEPTIC FROM SELF-INJURY
During the convulsive stage of a fit, the only treatment consists in putting a slip of wood between the patient's back teeth to prevent him from biting his tongue.

sympathy and attract attention. It is, however, probable that the performance is involuntary- it is a part of her disease.

Another type of fit consists of gymnastic movements—jumping, contortions or dancing till exhaustion ends the scene.

Yet another type is what has been called the dramatic type, histrionic attitudes intended to express various emotions being assumed (terror, defiance, appeal, attack, defence, etc.). Occasionally indelicate movements and attitudes are made and assumed. This phase may end in trance (catalepsy) which may last many weeks. The power to move a limb or limbs may here be lost or the patient may lose her voice. The fit is accompanied by distension of the abdomen (intestines) by gas and culminates in the passage of abundant urine.

The entire attack lasts from ten to thirty minutes—a much longer duration than that of an epileptic seizure. The patient is not generally completely unconscious, unless, perhaps, towards the end. It is, therefore, well for witnesses to be careful about what they utter.

3. In the Third or "Latent" Stage the patient is comparatively quiet, although there may be contractions of the arms, legs, fingers or toes, trembling of the limbs, various forms of paralysis. The contractions of the limbs may last indefinitely, but they may disappear suddenly, either spontaneously or under the ministrations of a faith healer. Séances have of recent years been held at chapels, where these sudden cures are not unknown. The patient may be left after a fit in a helpless condition, being unable to walk or stand. Any form of paralysis may be mimicked; although she retains the power of moving the legs, she professes her inability to stand. Pins may sometimes be stuck into her limbs without eliciting any expression of pain; she may also temporarily lose her sight, hearing or smell, and she may be dumb. These aftermaths of the fit are what are technically called *hysterical stigmata.*

First-Aid Treatment.—If you are sure that you have to deal with an hysterical fit, make the patient comfortable, and *leave her alone.* This will generally shorten the fit which entails no danger to life. On leaving her, see that officious bystanders also leave. This do-nothing policy may, at first sight,

appear unfeeling; it is, in reality, the kindest that can be adopted. The craving for sympathy in the hysterical person is almost unbelievable; the failure to satisfy it is a benevolent measure and should be always adopted.

INFANTILE CONVULSIONS

In infancy the nerve-centres are very unstable. The brain grows more during the first year of life than in all the succeeding years; this rapid growth predisposes to functional derangement. After the period of infancy, convulsions are much less frequent; after the age of seven years, they are rare. The majority of attacks occur in rickety children; indeed, where a child has convulsions without obvious cause, look out for signs of rickets. Convulsions are also often the first signs of the invasion of pneumonia and scarlet fever; less frequently of measles or diphtheria. In whooping cough, convulsions are more frequent than in any other infectious disease. Teething and worms are often said to provoke convulsions; acute and chronic indigestion are also amongst the most frequent causes. The presence in the stomach or intestines of undigested food is very frequently the exciting cause. One attack of convulsions renders the child more liable to a second, and where there have been several attacks, smaller and smaller irritations will cause a recurrence.

At the beginning of a convulsive attack the supply of blood to the brain is diminished; this is followed by the opposite condition, viz.: an engorgement of the veins. In infants who die during an attack, the brain and its covering membranes are intensely congested (full of blood); there may also be small or large hæmorrhages. The lungs are also deeply congested and the right chambers of the heart distended with dark clots of blood.

The Symptoms show, in some instances, warnings such as irritability, restlessness and twitchings of the muscles of the hands, feet, face or eyelids. In the majority of cases, these warnings are absent, the attack being sudden. The face is pale, the eyes fixed, only the whites sometimes showing; then twitchings begin in the eye or face muscles or in one of the limbs. These twitchings spread to all the body. In most cases, the convulsions become general; they may, however, be limited to one side of the body. There are grimaces, the neck is thrown back, the hands clenched with the thumbs turned into the palms and a quick spasmodic contraction of the extremities occurs. Consciousness is lost; the breathing is feeble, and the pulse weak, slow or rapid and often irregular. The face, at first pale, becomes blue. The contents of the bladder and bowel may be unconsciously evacuated. The convulsive movements are made up of alternate flexions and extensions of the limbs. The attacks last from a few moments to half an hour, the movements becoming gradually less frequent. When they cease, the child is in a state of stupor. The attacks may recur, but generally they are not repeated.

Death may follow a single attack; this is rare, unless the infant is very young and rickety. Death is due to asphyxia or exhaustion. The attack may leave no bad result; sometimes, however, it may cause serious brain damage, due most frequently to hæmorrhage into the membranes covering the brain. The attacks may be very numerous, one following the other. In these cases, the child may be left an epileptic, although this is unusual.

First-Aid Treatment.—Send for the doctor. Bearing in mind the condition of the organs brought on by the convulsions—brain intensely congested, the lungs and other body-organs in the same state, and the right heart gorged with blood—the indications are to bring the blood to the surface of the body. For this purpose, put the infant into a *warm* bath, and apply an ice-bag or cold compresses to the head. As soon as the child is quiet, give a teaspoonful of castor oil and empty the bowel by *slowly* injecting into it half a pint of warm water.

Never forget that in these cases the exciting cause is most frequently the irritation of undigested food in the bowel, especially if the child be rickety.

METHODS OF CARRYING EMERGENCY PATIENTS—I.
(1) Transport in an upright position by one bearer; (2) The "fore and aft" method with two bearers; (3) Demonstrating the three-handed seat.

TRANSPORT OF EMERGENCY PATIENTS

A FEW remarks on the means of transport of patients and on the method of utilising them will be useful.

The position which patients should assume during transport depends upon the seat of the injuries, if any exist, and also upon the symptoms present, *e.g.* shock, faintness, etc.

Thus (1) The Sitting Position will be suitable for those who are not very seriously injured in the upper segment of the body.

(2) The Half-Recumbent Position may be adopted for those whose chest-region is injured.

(3) The Recumbent Position is suitable for all very serious injuries of the head, chest, or abdomen; also for fractures and joint-injuries of the lower extremities. It is hardly necessary to add that cases of shock, syncope, and severe hæmorrhage should be carried in the recumbent posture.

It is taken for granted that, before transport is effected, First Aid has been given (fractures fixed, wounds dressed, etc.).

TRANSPORT BY ONE BEARER

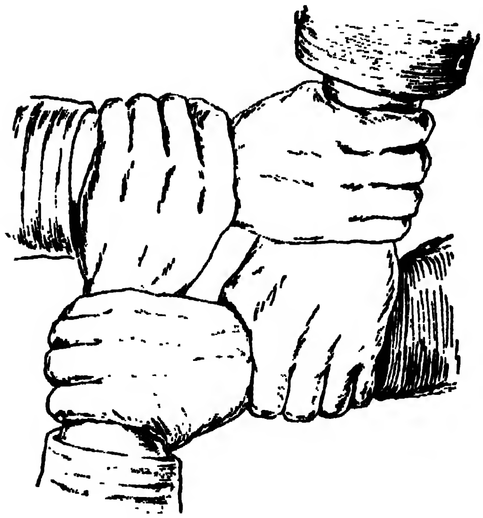
We will first deal with circumstances where only *one* bearer is available. The cases thus dealt with by one person include those whose injuries are limited to the head, neck, or upper segment of the body.

1. Transport in an Upright Position.—The bearer places himself on the uninjured side, puts his shoulder under the armpit of the patient who passes his arm across the back of the bearer's neck and so over his shoulder. The bearer grasps the wrist of this arm with the hand of that side and passes his other arm around the patient's waist.

2. In the Bearer's Arms.—This is a recommendable method where the patient is light and the distance short.

3. The Pick-a-back Method.—The patient gets on the bearer's back with the "well" arm over his shoulder; the bearer passes his arms under the patient's knees and grasps the wrist hanging from the shoulder with the hand.

The Fireman's Lift.—This is in use in the Fire Service. Kneel down on both knees just beyond the patient's head. Turn his face downwards, placing his arms straight



THE FOUR-HANDED GRIP
Showing how the two bearers grasp each other's wrists in the four-handed seat.

at his sides. Place your hands under his armpits, raise his body as high as is feasible in this position, allowing it to rest on one of your knees. Shift your arms so that they encircle his waist, interlocking your fingers in order to keep your arms in position. Lift him to an erect position; then, grasping his right wrist with your left hand, bring his right arm around your neck, stoop until your head is under his body, passing your right hand between his legs. Bringing his weight well on your back, grasp his right wrist with your right hand and rise to the erect position with the patient's body bent over your shoulders. If the patient be a female, pass your right hand over both legs. This lift should only be attempted by a *strong* man.

The French Fireman's Lift. Place the patient in a sitting posture, pass a strong strap or cord under his thighs, bringing its centre between his buttock-folds. Now cross the strap over the front of his pelvis, carrying the ends backwards under his arms. Then sit down back to back with the patient, pass the ends around your body and tie them in front of your chest. Now rise to the standing position.

TRANSPORT BY TWO BEARERS

The Two-handed Seat.—One bearer being on the right and the other on the left of the patient and facing inwards, each kneels on the knee nearer the patient's feet. They then place their hands beneath his armpits, raise him to the sitting posture, resting him against their other knees. They now pass their arms in front under the patient's thighs and lock their fingers with the palms uppermost. Having thus formed a seat, they rise together, lifting the patient from the ground, and placing their other hands on each other's hips, telling the patient to pass an arm around the neck of each bearer.

The Three-handed Seat.—This seat, suitable for patients who are not absolutely helpless while they are being lifted, is superior to the two-handed seat, being firmer and enabling the bearers to march better.

To form the seat, the bearers station themselves to the right and the left of the patient, looking towards him. The bearer on the right seizes his own left forearm with his right hand and grasps with his left hand the left forearm of the bearer on the left, who grasps with his left hand the right forearm of the bearer on the right, placing his right, disengaged hand on the left shoulder of the right bearer. Stooping, the two bearers place the seat so prepared beneath the patient's hips and lift him. The patient places an arm around each bearer's neck.

The Four-handed Seat.—This is a good seat for a patient who is not disabled enough to be unable to support himself by his arms placed over the bearer's shoulders when seated. It is also less fatiguing for the bearers than the preceding seats.

The bearers, placed on each side of the patient, facing each other, grasp their own left wrists with their own right hands and each other's wrists with their left hands. They now stoop, place the square seat thus arranged beneath the hips of the patient, who passes his arms around their necks as they rise.

In marching, the bearers should approach each other and the intervening patient as much as possible, the bearer on the right stepping off with the right foot and the

bearer on the left with the left foot (*i.e.* each with his forward foot).

IMPROVISED SEATS.—These are less fatiguing to the bearers than the hand-seats, and more comfortable for the person borne. Construct them out of canvas, a jack-towel, a board, straps, etc.

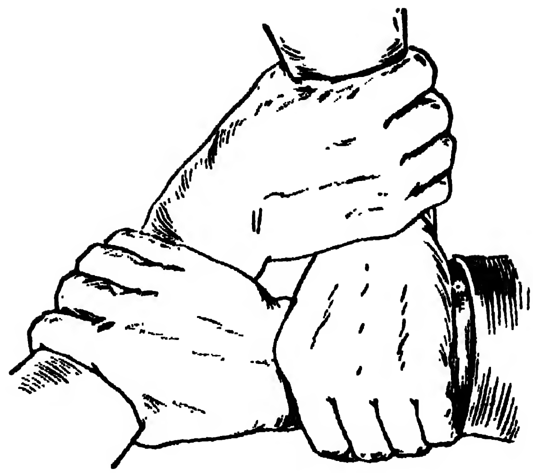
THREE FIREMEN'S BELTS SEAT—Formed by buckling together three firemen's belts so as to form a loop. Forming with this, by twisting, a figure-of-eight, pass the two ends of the loops over the heads of the bearers, allowing the centre to hang between them to form the seat. Lift the patient onto this seat after stooping to do so. Crossing their arms behind his back, they place them on each other's hips and rise, the patient passing an arm around a bearer's neck on each side.

THE HORIZONTAL POSITION.—This can be effected by the "fore and aft" method or by the bearers being on the same side of the patient.

In the first method, bearer A, placed at the head of the patient, stoops, puts his arms under the patient's armpits, interlocking his fingers in front of the patient's chest. Bearer B, placed between the patient's feet with his back turned to the patient, stoops and grasps the legs behind the knees. The bearers then rise simultaneously. If the patient be a woman, bearer B carries both legs under one of his arms.

When the patient is carried by the bearers on the same side, bearer A, kneeling on one knee, encircles with his arms the shoulders and thighs, while bearer B passes his arms under the legs, one just below the knees and one under the ankles. Now, rising together, they direct the patient to encircle the neck of bearer A. If one of the sides be injured, the bearers place themselves on that side.

A TWO-HANDED GRIP
The "hook-grip" used as an alternative two-handed seat.



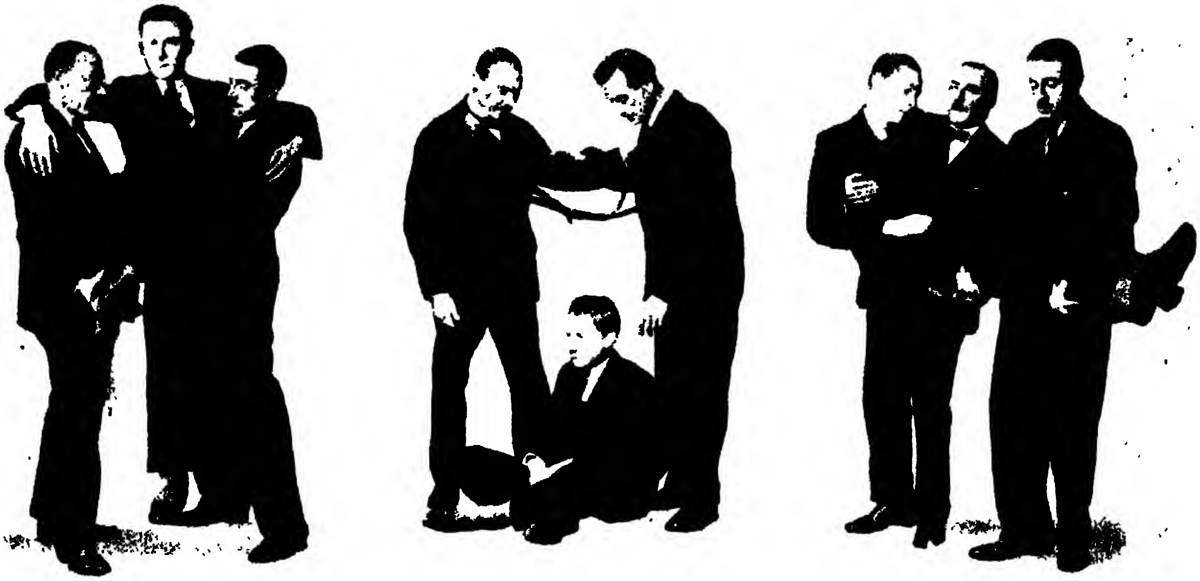
THE THREE-HANDED GRIP
Used for a patient who is not absolutely helpless.

TRANSPORT BY THREE BEARERS

This is an improvement on the preceding methods in cases of shock or grave injuries of the legs. Two bearers post themselves on each side of the patient's chest, facing each other, the third bearer being about opposite the knees (on the injured side). The three then kneel on corresponding knees (right or left). The first two bearers then pass their arms under the shoulders and hips, interlocking their fingers, while the third bearer passes his arms under the thighs and legs (one on each side of the fracture, if there be one). Raising the patient, they first support him on their knees, then they rise together to the standing position, the patient passing his arms across the shoulders of the first bearers.

TRANSPORT ON STRETCHERS

It is more than likely that a stretcher will, in the majority of emergencies, have to be *improvised* out of whatever materials may be at hand. For instance, a fairly efficient stretcher can be fashioned out of a coat and a couple of strong poles by turning the coat-sleeves inside out, passing the poles through them, and buttoning the coat. The patient sits on the back of the coat, resting his head and shoulders on the back of the front bearer. Should the patient require to be recumbent, add one or two more coats, utilising them in the same way. The poles may be held



METHODS OF CARRYING EMERGENCY PATIENTS—II.
(1) The three-handed seat used in a case of leg injury; (2) Three firemen's belts buckled together and used for emergency transport; (3) An alternative method of horizontal transport to the "fore and aft" carry, the bearers being on the injured side of the patient.

apart by fixing transverse pieces of wood between them fore and aft.

In the same way, stout sacks, with the poles inserted through holes made in the bottom corners may be used.

A less efficient method is to roll two poles on the sides of a spread-out rug, blanket or sacking, leaving sufficient space between them to form a bed for the patient. Two bearers on each side grasp with each hand the middle of the pole and a spot nearer the end. They have to walk sideways. Finally, a shutter, padded with straw or hay, may be utilised as a stretcher, the padding being covered with sacking.

To avoid accidents, test the strength of each of the above contrivances before placing the patient thereon.

Of ready-made stretchers, the "Furley" patterns are excellent. These patterns are the "Ordinary," the "Telescopic" and the "Police." The "Telescopic" is a modification of the "Ordinary," so arranged as to be convenient for use in confined spaces or on narrow staircases with sharp turns. The "Police" pattern is very strongly-built: the "Ordinary" is provided with straps for restraining unruly patients.

THE POSITION OF THE PATIENT ON THE STRETCHER.—Before putting the patient on the stretcher, notice the position and the nature of his injuries. Always keep the head low. If the head be injured, avoid pressure on the damaged part. If the lower limbs be injured place him on his back. If the upper limbs be hurt, place him on his back, or on the uninjured side. In injuries of the chest, keep that part raised and the body inclined towards the injured side. For wounds of the abdomen, if the wound be punctured or transverse, carry the patient on his back with his knees kept flexed by a roll of clothing behind the joints. If the wound be vertical, the recumbent position with the legs extended is recommended.

THE CARRIAGE OF THE STRETCHERS.—Try to prevent the movement of the bearers being transmitted to the patient; keep the stretcher level and as low down as possible without bumping against the ground.

PROFESSOR LONGMORE'S RULES.—"The front and rear bearers must 'break' the step by starting with opposite feet. By this means the stretcher is kept level and does not dip so much from side to side.

"The pace should be eighteen inches and

THE FIREMAN'S LIFT

Four positions in a method of transport only to be attempted by a strong man (1) Kneeling near the hea of the patient (turned face downwards) draw him up as high as possible with hands under his arms (2 Having shifted the arms to encircle his waist, lift the patient upright (3 Bring his right arm round your neck with your left hand, put your head under his body and lift him, passing your right hand between his legs and grasping his right wrist (4) Ready to walk away with the patient's body bent well over your shoulders

made with a steady but easy step, particularly avoiding elevation of the bodies by springing from the forepart of the feet. The feet should be firmly planted and the knee slightly bent.

"The bearers should, as far as possible, be of uniform height, build and age.

"A sick or wounded person should, as a rule, be carried with his face in the direction in which the bearers walk.

"Going uphill, the patient is taken head first; if downhill, the reverse.

"With fractures of the lower extremity, as a rule the patient should be carried uphill feet first, and downhill head first.

"No attempt should ever be made to carry a helpless patient over a high fence or wall, if it can possibly be avoided. A portion of the wall should be thrown down or a breach in the place made; if this be not practicable, pass through the first available gate or opening.

"Patients should never be carried with the stretcher supported on the shoulders."

SAVING LIFE IN THE WATER

By J. F. P. LLOYD.

Swimming and Health.

KNOWLEDGE of the exact and scientific methods which have been evolved during the past seventy years for rescuing those in peril of drowning and of restoring the apparently drowned banishes almost every risk attending one of the healthiest sports in the world--that of swimming. Man may be said to have power of mastery over the element of water, although his folly still frequently gives it the better of him. If he follows easily available advice and instruction, a healthy person faces fewer risks in swimming than in many strenuous land sports. He may combine a splendid method of all-round physical culture and of the development of nerve and courage, with a pastime in which gracefulness, rhythm and an exhilarating sense of freedom from the trammels of workaday life are given full play. The competitive and team spirits may reach their highest expression in swimming, yet no one is dependent on his fellows for his enjoyment of the sport. The most strenuous game in the world is water polo (it has been said that it is a game for men with the heart of the grizzly bear), yet to float with completely effortless ease with nothing but the sky above and the deep, sustaining ocean beneath is to know the elemental rest and joy of nature.

Children taught the A.B.C. of swimming take happily to a form of exercise which ensures strong and straight development of mind and limb. Women not only hold their own with men in the water, but often excel them in gracefulness and even in endurance, the lightness of a woman's bones giving her an added buoyancy. Breath control is essential to good swimming and the deep regular breathing of the swimmer ensures the full expansion of the lungs, which are ordinarily incompletely exercised. Complete elimination of human waste, which is assuming an increasing importance as the basis of preventive medicine, is assisted in its four-fold aspect while swimming, through the action of the bowels, kidneys, lungs and skin. It is a common saying that a bath of air is good, a bath of water better and a bath of sunlight best. Swimmers usually get all three at the same time. No other exercise can so well tone up the skin and lungs to do their essential cleansing work as can swimming.

Every swimmer should know something of the working of his body, not only to avoid possible injury to it, but to understand the beauty of the human machine, and familiarity with the facts of circulation and respiration is highly important to any one who seeks to be prepared to save life in an emergency.

Death from drowning—that is, by asphyxia or suffocation—is caused by the water choking the windpipe so that the lungs are unable to obtain any fresh supplies of oxygen. The impure air accumulates and consequently the blood which is pumped all over

the body is of the venous kind. Unpurified blood reaching the brain quickly deprives it of its activity and power to control the muscles. Consciousness ceases and the heart fails.

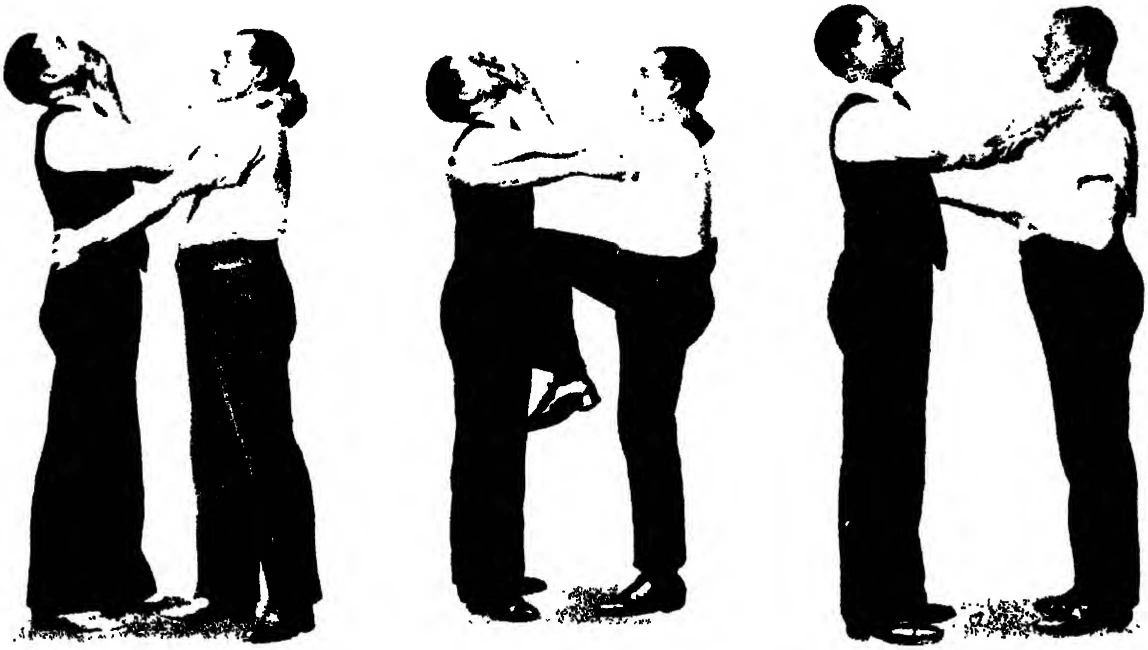
It is from this condition of suspended animation that the various methods of resuscitation are successful in restoring a man to life if they are employed in time. Often after three or four hours of unceasing, but apparently hopeless effort, the heart begins again to beat and the lungs to dilate with air without assistance. Treatment to restore the circulation and warmth of the blood and general treatment for shock are then applied.

Before passing to a description of the methods of resuscitation and their evolution, it is well to explain the physiological basis of the oft-repeated advice given to bathers not to enter the water immediately after a meal. At many French watering places notices are posted urging visitors not to bathe until two hours after taking food. The ideal time to swim is two hours before feeding. This is explained by the fact that two distinct blood systems are in operation in the human body, one called the splanchnic, which supplies the abdomen and digestive tracts, and the other called the systemic, which supplies the brain and limbs. During physical exercise the systemic is called into preponderant activity and after food the splanchnic is normally most busy enabling the body to assimilate. Sleepiness is induced by eating because the blood stream is by this means diverted away from the brain and limbs. It will therefore be easily seen that vigorous exercise immediately after taking food not only diminishes the supply needed for proper digestion, but prevents a concentration of the blood supply on the limbs and brain. Both digestion and physical efficiency are thus greatly impaired, and an undue strain is put upon the heart. Often this strain is highly dangerous and to people with some heart weakness—perhaps a latent one—it has frequently proved fatal. Cramp, or violent and involuntary contraction of the muscles, so common a cause of bathing fatalities, is generally held to be due to a shortage of blood in the part concerned, and is much more likely to occur in one whose blood supply is directed towards digestion.

When to Bathe.

A moderate swimmer with ordinary courage and strength can go to the rescue of a drowning person with confidence if he is acquainted with the method laid down for releasing himself from the frantic clutches of the man or woman in distress. A drowning person is often temporarily insane and rarely considers that he is throwing away his only chance of rescue by clinging wildly to his would-be rescuer. If he will clutch at a straw his grasp of a fellow human being will often be virtually a stranglehold. Calm and presence of mind in the rescuer is as essential as a knowledge of the releases. A person falling out of his depth into water and unable to swim usually rises to the surface owing to the buoyant effect of the air in his lungs, and also, when he has fallen in fully-clad, of the air in his clothes until they become saturated. He will probably raise his arms and shout for help on emerging and by so doing will cause himself to sink again. Below the surface his struggles will make him swallow a quantity of water, but if he ceases to struggle he will probably rise again. There is no truth in the common belief that a drowning man always rises three times. He may not come to the surface at all or he may rise many times according to circumstances. As soon as he becomes unconscious he sinks altogether owing to the quantity of water in the stomach and the loss of air from the lungs.

A swimmer who sees a person in difficulty should first think of saving every second. If he can get rid of some of his clothes before plunging into the water the few seconds lost in so doing will probably be made up by his power to swim faster. The boots or shoes should be removed first if in the rescuer's judgment there is time to discard anything. Should the plunge to the water be from any considerable height, or into water of doubtful depth, it is best for the rescuer, unless



LAND DRILL FOR RESCUE OF THE DROWNING—I.
(1) Breaking the clutches of a drowning person by holding his nose and forcing his face under water; and (2) by pushing the man's body with the knee, one hand being on his shoulder and the other on his chin and nostrils; (3) bringing ashore a man suffering from cramp, who should float on his back and clasp the rescuer's shoulders.

he is an expert diver, to jump feet first. Before diving so he should take a deep breath. In cases where the water is full of weeds the swimmer should make short paddling strokes to avoid entanglement. In approaching the drowning person it is best to do so from behind if possible. Unless the rescuer is proficient in release methods, he should certainly do so, but there is no danger in approaching from the front if the rescuer knows how to break front holds.

The three methods of release are as follows: In cases where the rescuer is held by the wrists he should twist his arms sharply outwards and downwards so that if the drowning person does not let go his thumbs are dislocated. There should be no scruple in employing such drastic means as two lives depend on prompt action. Similarly if held round the neck the rescuer should force the struggling person's face under water at the same time holding his nose so that he will swallow water and choke. To do this the rescuer should take a deep breath, lean well over the other's body and pass the left arm round his waist. With the right hand he should push the drowning person's head back as hard as he can, the palm of his hand on the chin and the fingers pinching the nostrils. The third method is for use when clutched round the body and arms or round the body alone. The rescuer should first attempt to draw his arms upwards in front of his body. When he has freed them he should place one hand on the man's shoulder and the other against his chin, as in the release from the neck hold. While pushing the head back under water, as described above, he should endeavour to raise his knee and force it against the man's body. After release the rescuer should get his subject on to his back. Once the person in peril finds that he can breathe freely again, he will probably regain his calm of mind and allow himself to be towed to safety without struggles.

Breaking the Clutches.

There are a number of rules laid down for bringing a person safely ashore. Whether the patient is insensible or not, it is of the greatest importance to keep his face all the time above water. Apart from other consequences a fresh immersion might excite him to renewed struggles after he had regained calm. The commonest way for the rescuer to swim is on his back, using his legs to propel himself. If the patient is calm it will be easy to keep him afloat by supporting him with a hand at each side of the head covering the ears, but should he still struggle he should be firmly grasped just above the elbows and his arms extended at right angles to his body. In the latter position he is powerless to turn over. A rescuer may swim with the breast stroke in bringing ashore a bather suffering from cramp. The person assisted should extend his arms, clasp both shoulders of the rescuer and lie on his back with his head well back. By swimming above the assisted person the rescuer will have arms and legs free. An overarm swimmer may bring a person to safety by passing an arm under one arm of the subject and across his chest, taking a firm hold at the opposite armpit. The swimmer will thus have one arm and both legs free.

The primary object of all resuscitation methods is to promote respiration artificially until it becomes automatic by reflex action as in normal health. There is no record in ancient literature of the revival of the apparently dead from drowning. Not until 1650 do we hear of the feat being performed. In the eighteenth century the Dutch led the way by forming a society for giving instruction in life-saving methods in drowning cases after several instances of successful treatment had been reported in Switzerland. This society also provided for a reward to be made to any one who applied the method

LAND DRILL FOR RESCUE OF THE DROWNING—II.

(1) A hold for an over-arm swimmer; he passes his free arm under one arm of the patient, across his chest and grips at the opposite armpit; (2) position of a rescuer swimming on his back and clasping a drowning person round the body; (3) swimming on his back and supporting a calm patient by the head.

with success. The memoirs of this society were translated into English shortly afterwards and attempts were made to found a society in this country. Strange to say, many objections were raised, and a pioneer named Dr. Hawes of London received no general support in a task which he set himself to do alone. This was to organise the Thames-side workers into life-savers by offering rewards for the rescue of the drowning. Dr. Hawes's method was to inflate the lungs with a pair of bellows through one nostril while the other was closed. The chest was then pressed so that the air was expelled. The patient was slung up in a sort of cradle above a fire. In some cases Dr. Hawes also bled his patients, had them held up by the heels and rolled them on barrels. He paid the rewards out of his own purse for some time and was the cause of a number of persons being saved. Gradually he won supporters, and from his initiative the Royal Humane Society sprang in 1774.

Artificial Respiration.

The method most generally in use to-day and the one officially recognised by the Royal Life Saving Society is that of Professor Sir E. Sharpey Schafer F.R.S., of Edinburgh, a past-president and general secretary of the British Association. The Schafer method is the result of long researches by a distinguished physiologist, and has many advantages over earlier systems such as the Marshall-Hall, the Howard, and the Silvester system. Dr. Marshall-Hall introduced his plan in 1856. It provided that the patient should be rolled from side to side face downwards at the rate of about fifteen times a minute while pressure was applied between the shoulder blades. In Dr. Silvester's system, introduced in 1857, the subject was laid on his back while his arms were raised above his head and then folded and pressed against his chest. Dr. Howard's method, published twelve years later, also suggested that the patient should lie on his back, but instead of working the arms to inflate and deflate the chest, the operator applied pressure with his open hands to the lower part of the chest. On the Continent similar systems were introduced during the later part of the nineteenth century, notably those of Dr. Schultz, Dr. Schuller and Dr. Paasch in Germany, and Dr. Djelitzen in Sweden. The Schafer method was introduced in 1903, and adopted by the R.L.S.S. in 1907. It is now almost the only one taught in this and many other countries.

When a person is taken from the water apparently dead, every second is of the utmost importance if life is to be saved. The rescuer should not stop to remove any clothing from the patient, but should lay him on flat ground face downwards, the head resting on one side with the arms forward and bent so that the palms of the hands rest on the ground. Quick but gentle action should be used. Violence will not only increase shock, but as all the muscles are relaxed, it may cause dislocation to joints as well as injury to congested organs.

A doctor should be summoned at the earliest possible moment. If natural breathing is only partially suspended it may be sufficient to stimulate it by applying smelling salts or some such irritant to the nostrils, but if there are no signs of life the operator should perform artificial respiration as described in the section on "Asphyxia." (See pages 1151-1158).

When the patient is breathing naturally the work is by no means over. Treatment to restore the warmth and circulation of the blood must be given. He should be turned over on to his back—cautiously to avoid dislocating a joint of the arm—and rubbed briskly over the surface of the body with towels, flannel or any available rough material. If possible the patient should be carried to a house or shelter and the rubbing continued. Friction should be towards the heart so that the blood will flow along the veins to be returned to the lungs for reinvigoration with oxygen. Warm blankets should be wrapped about the parts not being rubbed and hot-water bottles, heated bricks wrapped in flannel, or bladders filled with hot water applied to the base of the stomach, the armpits, between the thighs and to the soles of the feet. Before the patient

is allowed to rest he may be given a sip of warm water to test his ability to swallow. If he can do so, some stimulant such as a small quantity of warm water and brandy may be given. If breathing is laboured a hot poultice applied to the chest will be a relief. It is important to watch vigilantly to make quite sure that breathing does not fail. Sleep, in a well-ventilated room, is what the patient now needs more than anything else.

Courtesy] [Royal Life Saving Society

RESCUE BY REEL AND LIFELINE

A method of rescue from breaking surf which originated in Australia and has recently been adopted by the Royal Life Saving Society.

Reel and Life-line.

A method of rescue from breaking surf by reel and life-line has recently been adopted by the R.L.S.S. The method originated in Australia, where much time and trouble have been spent in perfecting it. In America the life-line method is in use on a number of the popular beaches. Two men rush to the scene of the mishap with the apparatus, and when one has dashed into the water to secure the drowning man, the other assists the two to dry land by hauling on the line. The standard apparatus consists of the reel mounted in a solid frame and capable of being wound up by a handle or checked by a brake. At the end of the line is a cork belt which is worn by one linesman who swims to the rescue. When the drowning person has been secured by one of the methods described, the other rescuers haul the two in. A series of signals for the squad has been agreed upon as follows :—

One arm raised upwards—Patient secured; haul in.

One arm raised and lowered vertically—Pay out or haul in faster.

One arm raised and waved from side to side—Haul in slower.

Both arms raised—Lost hold of patient ; pay out line.

The Royal Life Saving Society owes its existence to the foresight and devotion of Mr. William Henry, who died in 1928 after thirty-seven years spent in developing the nucleus which he formed in 1891. The society was known for thirteen years as the Swimmers' Life Saving Society, but in 1904 King Edward granted the right to the title of Royal. William Henry's original drills, three for release from the clutches of the drowning and five for bringing the person to safety, remain fundamentally unchanged. As lecturer and demonstrator, the founder of the society travelled the whole world, and was constantly widening its scope and sphere of usefulness. In the second year of its existence eighty-six awards were granted, last year the number was 45,549. The society's diploma is now regarded as the highest honour to be gained in the realm of swimming. William Henry, himself one of the finest all-round swimmers in the world, not only devised methods of rescue for use by the able-bodied, but found means of enabling the blind and those who had lost a limb to ensure their own safety and to resuscitate the drowned. The awards granted by the Royal Life Saving Society are in order of precedence, the Diploma, the Award of Merit, the Honorary Instructors' Certificate, the Teachers' Certificate, the Bronze Medallion, the Proficiency Certificate, and the Elementary Certificate. The society does not grant awards for bravery in saving life. This is the function of the Royal Humane Society.

Courtesy] [High Commissioner for New Zealand

A NEW ZEALAND LIFE-SAVING TEAM

The life-saving team at Lyall Bay, Wellington, equipped with reel and life-line for rescuing surf-bathers.

Removing Clothes in Water.

Ability to remove the clothes while swimming is sometimes important to a life-saver, and is always useful for teaching confidence and nimbleness in the water. It can be practised on land by standing with one's back a few feet from a wall and arching the body backwards so that it is supported by the head. This is a similar position to that in which the lower garments should be removed whilst in the water. To take off the upper garments lie flat on the back. In the water the best way to remove the shoes is to float on the back and bend each foot up under you, using one hand to untie the laces. Each shoe can then be pushed off with the opposite foot. A little practice will soon simplify the process, but in the water the most important thing to remember is to keep calm and to use unhurried movements, especially when the limbs are entangled for a moment in the loose garments. Swim out of your clothes as much as possible.

Advice to Swimmers.

The best general safety advice for bathers is that they should leave the water before the body loses its natural heat. Most bathers stay in until they begin to feel chilly, whereas they should come out while the warm glow is still on the skin. Vigorous rubbing with a rough towel should be regarded as part of the bathe. The whole body should be immersed at once on entering the water. One bathe a day is enough for the most hardy person. No one should enter the water when he feels shivery or when he is cooling after perspiration. Neither should any one bathe in lonely places where help would be unobtainable in an emergency. If cramp should occur, the swimmer should, above all, keep a level head and presence of mind. He

should float on his back and rub and stretch the limb affected to see if the attack will pass off. In any case he should try to get ashore as quickly as possible, using the back stroke and calling for help if it is near at hand.

Bathers should never "cry wolf" in the water for fun. Even a slight attack of cramp ought to be regarded as a serious warning never to venture far from bathing companions who can swim. Persons who quickly get cold in the water or who suffer from palpitations or giddiness should see a doctor before bathing again.

XVIII
CLOTHING AND HEALTH

By C. W. SALEEBY, M.D., Ch.B., F.R.S.E., F.Z.S., Founder and Chairman of the Sunlight League; author of "Sunlight and Health," etc.

FOR various reasons we must usually wear clothes, but the capital fact is that we are born without them—assuredly as if Nature did not think them necessary. And doubtless they were not necessary to our remote ancestors. Man took his origin somewhere in a warm climate; but he has determined to occupy every part of his earth, tropical and polar, maritime and mountainous alike. Wherever he be, he must maintain his blood at a practically constant temperature of about 100°F.—alike under the terrible heat of the equatorial sun, or in the frozen north. How he does it is a perpetual miracle to the physiologist; but do it he must or die and that speedily. Clothes should be looked upon as a more or less occasional and special invention of the human mind in order to aid in the task of maintaining the human body at a constant temperature in external conditions for which it was certainly not evolved. In our damp and northern islands, we have this problem in a very serious form, and there is abundant evidence to show that we have frequently failed to solve it.

It is complicated by various considerations which have nothing whatever to do with physiology or climate or the temperature of the blood. More entirely adventitious considerations include notions of modesty, decency, propriety; fashion, custom; ostentation and desire for distinction; and ideas of beauty. These mightily complicate the task of the hygienist, who is apt, for instance, objecting to the dirty inconvenience of long skirts, to invent a hideous garment such as that named after the late Mrs. Amelia Bloomer, who doubtless meant well but achieved ill. No one in his or her senses wants to be made hideous or ridiculous, and the reformer must contrive to remember this whilst he seeks to serve the physiological needs of the body.

It may briefly be said that we dress for *decoration, defence and decency*. Here, of course, our concern is with health, and we must try to learn what is the best clothing, in respect of the easiest and longest working efficiency and happiness of body and mind; and leave it to further inquiry how this best clothing may also be made the most beautiful, as all but enemies of joy must desire.

The best clothing is the least possible in the circumstances. That is the first proposition: very simple and perhaps at first rather startling, but not advanced with any such intention. It is irrefragably based on our knowledge of the skin and its natural relation to light and air, two of the essential things by which we live. This knowledge, though very simple in its essence, is comparatively new, but it is already certain and established.

The Responsive Skin.

The skin is not merely a mechanical covering of the body. It is alive, intensely and actively alive. It is meant to live in light and air—that is certain. Frequently we may bathe it in water, but it could not survive perpetual immersion, for in time the water would penetrate and destroy the skin cells. Light and air, on the other hand, are always its

proper media, as proper for it as is water for the extremely different skin of a fish. Elsewhere in this work we learn something of what light and air do for the skin, and for the whole body through the skin. Here we need merely remind ourselves that light is the only skin food, actually creating vitamin D in a certain constituent of the skin cells, and directly warming the blood, thus saving us the trouble of consuming, digesting and burning up a corresponding quantity of fuel food in order to maintain its temperature.

Further, the skin is richly supplied with blood-vessels, capable of wide variations in size, as every one knows who has ever blushed or had a cold nose, and these blood vessels are under the control of a very complicated nervous apparatus which has its centre in the brain, and controls the distribution of blood to every part of the body. The blood supply of the skin is one of the essential means whereby the temperature of the body is maintained at its proper level. During violent exertion, which makes heat, or in a very hot atmosphere, the skin becomes congested with blood in order to lose heat to our surroundings and keep us cool. On the other hand, when a cold draught blows upon the skin, we sneeze, because the nerve essentials in the brain promptly take fright, lest we be chilled to death "where we live," and give orders for the flooding of the lining of the nose, so that the air entering our lungs, vital organs, may be warmed. These are illustrations of the general proposition that one ought to have a *responsive skin* for health. This is essential. No one can have such a skin who coddles it with clothes into a permanent state of semi-paralysis. But this paralysed skin is the possession of nearly all civilised men to-day.

Children need vitamin D most: and with them we should count expectant and nursing mothers, whose bodies are working for those of children. In our country the supply of ultra-violet light of the particular wave-length which makes vitamin D in the skin is very scanty indeed during a large part of the year, and is never more than just enough for our needs. If it were not for the possibility of obtaining this vitamin in our food, we could not live in our present cities at all. But clearly it is our business to arrange, as far as possible, that at least we do receive into our skins as much as possible of the exiguous supply of these precious radiations which can serve our lives so well. Hence another reason for my proposition that the best clothing is the least possible in the circumstances.

The girl of to-day is the best and most delightful illustration of our first proposition.

The Modern Girl.

She has greatly reduced her clothing and greatly profited. This fact, which began as a prediction on the part of a few of us, who had *studied the skin*, is now familiar, and is repeated as an original discovery by nearly all contemporary writers. Most readers therefore know to-day that the "pneumonia blouse," falsely so-called, makes its wearer less and not more liable to "colds" and chills.

It is not quite true that we are born naked into the world. It is not true at all—for the first few days. We are indeed born with a complete covering, called the "*Vernix caseosa*" or "cheesy varnish." This is the "birthday suit" of man that is born of woman. It is a fatty material, well described by its scientific name. True to the absurd history of our subject, and acting, as ever, on the principle that whatever Nature does is wrong, we proceed to wash the baby at the earliest possible moment. The hapless infant is therefore deprived of its perfectly fitting and costless coat of fatty varnish. The ceremony of washing the baby is one of the first that the young nurse has to learn in a maternity hospital. But recently Professor Louise McIlroy at the Royal Free Hospital, London, has taken the temperature of infants born there, under exact conditions, and has found that the loss of this cosy coating costs the infant several degrees of heat, just when it ought to keep warm.

The rule now, at the Royal Free Hospital, and other enlightened obstetric centres, is that the infant must not be washed. This does not mean that, for instance, its eyes are not to be most carefully cleansed, but

it does mean that the warm coat which gradually wears away as the skin beneath learns its new duties, shall not be stupidly destroyed.

When those new duties have been learnt, which is very soon, we are better with the minimum of clothes. The familiar remarks about the vigour of modern girls falls far short of the truth, which is that, to take one instance only, an extremely common and disabling disease, which has been familiar for many centuries, has vanished from under our eyes, almost as we looked at it, within the present century. It was everywhere in 1901 and nowhere in 1921. Meanwhile the medical profession had made no discoveries whatever about it, no campaign, small or great, had been directed towards its study, its cure or its prevention. It vanished because young women chose to change their mode of life.

Green Sickness.

The scientific name of the disease in question was *chlorosis*, and in Shakespeare we read of it as the "green-sickness." It was also called simple primary anæmia, to distinguish it from pernicious anæmia, a disease formerly always fatal, but now readily controlled and banished by a diet of liver or kidney. In chlorosis the skin had a sickly greenish aspect. The girl was pale, perhaps too plump, breathless on very slight exertion, destitute of vigour or *joie de vivre*, and usually constipated. Her muscles were feeble, she could not burn her fat, murmurs were heard in the region of the heart and the great veins ; she was a burden to herself and all about her. At the beginning of this century we saw such girls wherever there were any girls at all. There were millions of them. They furnished recruits for the sad and monstrous army of the consumptives, the chronic dyspeptics, and so forth. Where are such girls now? They are gone, and gone for good. Light and air have done the beautiful work of preventive and creative hygiene, and these victims of the stupid, hideous, disgusting and abominably cruel clothing and confinement of the nineteenth century, which called its fatuous treatment of girlhood moral and decent and proper, are seen no more.

The consumption death-rate has meanwhile fallen fast and far among young women, as we should expect. I insist on this fact because the question of clothing has not been properly related, as it should be, to the general transformation in our ideas about the open air and the prevention and treatment of consumption and the rest of the diseases of darkness.

Diseases of Darkness.

To-day we all condemn the stuffy, dark and humid atmosphere and "climate" of the kind of room in which consumptives used to be done to death. If the sanatorium principle is right, then the present clothing of men is wrong. Under the clothing of the average man his skin is imprisoned in a dark, stuffy and humid atmosphere exactly such as every student of hygiene to-day condemns as predisposing to disease and especially to tuberculosis. Therefore, I submit, such clothing stands condemned.

In so far as we must wear clothes, there are certain natural principles which we should follow.

For instance, our clothing should be loose. All tight clothing is an abomination. There is no exception to this rule. Even a surgical splint or truss must be so contrived that, though firm and strong to meet a special mechanical need, it is not tight. Tight, stiff and heavy clothes are an affront and a menace to the marvellous soft strength of the human body. Vanity in this respect always receives a punishment that fits the crime. Tight shoes and gloves deprive feet and hands of the blood they need to keep them warm, and we are punished with the disfigurement of chilblains. Corns and bunions come into this category. The peculiar liability of the joint of the big toe to attacks of gout and other maladies depends on the fact that our present habits of footwear make this the most cruelly and persistently maltreated joint in the body. Tight garters conspire with the other causes of varicose veins.

Loose Clothing Essential.

Corsets which are in any measure tight

are to be utterly condemned. The true supports of the trunk are its own muscles. This is what we learn at Leysin, where plaster of Paris is never used even for a tuberculous spine, but where sunlight and the cool air develop what Professor Rollier calls "le corset musculaire." The result is the trunk of an athlete, such as all rightly admire and desire. The steel and whalebone abominations now nearly obsolete were primarily designed for purposes of sexual attraction, to draw attention to the bosom and pelvis, which are the most conspicuous of the "secondary sexual characters" of woman. They weakened the abdominal muscles, restricted diaphragmatic breathing and caused disastrous downward displacements of internal organs. The recent attempt to substitute rubber corsets has largely failed, as it deserved.

Tight and high collars or neckbands of any description are also noxious. Even if not tight they obstruct light from the valuable thyroid gland in the neck, and conspire towards its malnutrition. No child should wear a tight bib, which promotes mouth breathing. The neck should not be clothed at all. There is reason to believe that tight collars, by retarding the return of venous blood from the head, are prejudicial to the health of the scalp, and thus predispose towards seborrhœa and baldness. No child should wear a tight hat string or elastic. The same suspicion attaches to hard-rimmed hats. Unless for special reasons of protection, the head should be unclothed. The air and light are good for it. But in strong sunlight, which includes powerful heat rays, we must guard the head against overheating, and should wear something of the type of a white linen hat with a brim all round, or a panama. Here we may recall the comprehensive dictum that, for the achievement of health, you should "Keep your feet warm, your head cool, your bowels open and your mind easy."

The clothing of children demands especial consideration, now that we have laid down our general principles. Being small, they have a large surface in proportion to their mass, and thus cool easily. We must not let them be chilled. Meanwhile, we wish them to receive abundance of sunlight. Modern fashion has mercifully released much of the skin-surface of children; but when such fashion exposes young limbs, unclothed, in the sunless, chilly, and damp winter, its results are apt to be disastrous. The *golden mean* is as necessary to aim at to-day as in the day of Aristotle. A warning is therefore necessary, especially in our country with its appallingly high incidence of rheumatic fever in children, and of consequent heart disease.

Children's Clothing.

Cold and damp predispose to rheumatism, and we must clothe ourselves and especially our children, so as to protect against them. If feet in general should be kept warm, especially should the feet of children—and the aged, in whom certain of the needs and risks of childhood are repeated. Water is a good conductor of heat, and therefore feet should be dry. This does not mean that children should not paddle in summer in the sea. Feet in leaky boots are in danger, but that is nothing at all compared with the fact that when feet are so, the heart of their owner is in danger too. Amongst the countless follies, stupidities and cruelties of our present methods of education is the tolerance of a system whereby children get their feet wet on the way to school, and sit there asking the germs of rheumatic fever to attack them.

Here it should be added that there are no such things as growing pains. The normal growth of childhood is painless, of course. Growing pains, falsely and fatuously so-called, are rheumatic. They are serious danger signals. They require us to take urgent and effective steps, amongst which is the thorough protection of the child from cold and damp by means of good clothing, *from the feet up.*

The most perfect illustration of how not to dress a child is furnished by an Eton boy in the proper costume of his school. His clothes are very expensive to buy and to maintain. His long trousers are entirely

[Photopress

A CONTRAST IN MODERN DRESS [Topical

Above—Eton boys in midsummer, wearing the traditional costume which, according to modern ideas of hygiene, is thoroughly unhealthy. *Below*—Representatives of South African contingents of Boy Scouts demonstrating the type of clothes—loose and comfortable and admitting air to the body—most suitable for modern youth.

senseless and deprive him of much light and air. The hideous absurdity of trousers becomes evident nowadays when we are familiar with the female leg clad in stockings only. Those stockings, made of thin silk for beauty, might often be open to the criticism that they did not sufficiently protect the foot; but the tennis girl has introduced little woollen socks, as an addition, widely copied by other girls in cold weather. The Eton boy's jacket is ridiculously short--this being due, as we know, to the greed of a former master who made money on the boy's clothes by reducing the amount of cloth in the jackets. Accordingly the region of the kidneys must now be exposed, long scores of years after, in Eton boys of to-day. The costly collar is evidently indefensible, and the silk hat is the entire negation of all rational principles in dress.

If we want to know how to clothe a boy, we have only to turn to the one great masterly achievement in education, anywhere throughout the world, in modern times, which is, of course, the creation of the Boy Scouts by Lord Baden-Powell. In their uniform we see the principle of shortening of stupid superfluity applied admirably. Just as, in modern infant hygiene, we have abandoned the senseless and obstructive long clothes of past generations, and just as women have shortened their skirts, so the Boy Scout wears shorts instead of trousers. He wears sensible, roomy boots or shoes with space for his toes to live in without the development of corns, bunions, hammertoes or other ugly deformities which are almost universal in the modern civilised foot. His neck and throat are free; and though civilisation will collar him in time, for a time, as it has collared us of an older generation, we may hope that, ere long, he will insist on the freedom of neck and throat which he had as a Boy Scout, and which all women enjoy already. His shirt is practical, does not incarcerate his neck, not costly, well-washable, durable and comfortable. If and when he wears a hat it is also comfortable, without a hard rim, and with a useful brim against excess of sun.

Youth and Age.

In studying the clothes of children we may lay down a new principle. It is that, on the whole, we need most food and least clothing when we are young, and least food and most clothing when we are old. It is impossible to consider clothing without relation to food, seeing that, in our climate, the chief use of clothing is to keep us warm—by preventing loss of heat, and the great bulk of our food is fuel, needed for exactly the same purpose—which is achieved by the production of heat. Now in childhood and youth the fires of life burn bright and strong; metabolism is active, as the physiologists say; much construction is afoot; movement is almost perpetual; food must be generously supplied, abundant heat will be generated by its combustion, and little clothing will be required as a rule. The health and vigour of young children in this country steadily improve and their clothing is now much reduced. The most widely distributed disease amongst young children is rickets, which is primarily due to lack of sunlight and for which the remedy is therefore less obstruction of light by clothes and more foods rich in vitamin D.

But observe the contrast in the later years of life. The internal fires are now slow and low. The child was always restless and moving, the old man remains immobile for long periods at a time—making no heat as he would do if engaged in exercise. Abundant fuel food is not good for him; he will not use it, and will only be injured by it. Nevertheless, he must be kept warm. Chill is his enemy, no less than when he was a tiny, easily-cooled baby. Since he cannot be kept warm in the ideal way, which is central heating in the proper but never employed sense of that term; since he cannot burn abundant fuel in his muscles, and thus heat his blood from within, he must be kept warm by careful conservation of what heat he does produce. Therefore he goes to a warm climate, or dons warmer clothing.

This most emphatically does not mean that he is to deprive his skin of sunlight. On the contrary, the well-known loss of

mineral salts in the bones of the elderly, and their consequent liability to fractures, especially of the neck of the thigh bone, and the slowness with which such fractures heal, may partly be due to the fact that elderly people stay more indoors, get less sunlight, and thus run short of the vitamin D without which the body cannot retain the lime and phosphorus which constitute the principal salt of the bones. The elderly, therefore, should be warmly clothed, lightly fed, frequently supplied with sunlight, and perhaps especially supplied with foodstuffs rich in vitamin D, of which the most noteworthy are cod-liver oil and the recent concentrate of vitamin D known as ostelin.

Clothing Materials.

What materials shall we use for our clothes? Of course we may use special and exceptional materials such as rubber, for special needs—to keep out the wet from our feet, or to protect us if we are mule-spinners in Lancashire cotton factories and *must* keep a certain mineral oil away from the skin if we do not want to develop cancer. But, whilst the study of special protective clothing, in factories, in aeroplanes, in X-ray departments and radium institutes, is fascinating and important, the great majority of people are concerned simply with the kind of material for everyday in the ordinary way.

If we wear one layer or many, that next the skin is the most important. It must not be irritant. It must not contain dyes, like certain cheap furs, which actually poison the skin; and it must not be so coarse in structure as to produce a "flannel rash" or anything of the kind. Since we perspire, the layer next the skin must be absorbent. This is a matter of *fabric* rather than fibre. "Wool next the skin" has a kind of semi-sacred significance in this country. But the question is not the origin of the material but the type of texture. A dense, non-absorbent flannel "chest-protector," really a chest-weakener, is a perfect example of the worst possible type of clothing, even though it be made of wool. Shetland wool, on the other hand, conforms as nearly as possible to the ideal, which we actually see in the coat of the sheep. Next the skin we may wear silk, artificial silk, cotton, linen or wool according to our preference and the circumstances—as of climate and convenience for our occupation—*provided that the fabric be loose, absorbent and washable.* A loose fabric, of whatever fibre, is always a warm one for its weight, other things being equal, as we see in the natural clothing of hairy and furry animals; for such a fabric holds air in its meshes, and the air is a poor conductor of heat, and thus helps us to retain our warmth. Consider our warm-blooded cat, who sleeps out of doors on a cold night and does not get pneumonia. The cat's clothing is loose in texture, and deliciously warm. Its weight is very nearly nothing at all. There we see our unattainable ideal!

The cat's clothing is not only loose and light, but ventilated. To admit air to our rooms is not enough. We should ventilate our skin under our clothes. This keeps the skin alive and it helps to carry away the perspiration—a very valuable result. We see the point if we contrast a thoroughly insanitary garment like a pair of trousers with the Scotsman's kilt, which is warm where warmth is needed, but permits of ventilation.

Recently, having learnt the value of light, we have studied clothing in respect of its power to transmit the precious ultra-violet rays. This inquiry was begun by Dr. A. F. Hess of New York, from whose laboratory in Columbia University I brought back in 1922 some examples of mercerised cotton which he had examined. They were examined by Professor Leonard Hill and he confirmed the finding of Dr. Hess, that the white cotton transmitted ultra-violet rays, whilst the black, otherwise identical in every particular, did not. I examined the materials with a lens and found that the dye had not swollen the fibres nor diminished the spaces between them. The physical explanation of the fact is not clear, but further inquiry shows that, for any given material, it is the white that is most likely to transmit the ultra-violet rays. Even the comparatively

[Topical

A BID FOR FREEDOM

Costumes devised by the Men's Dress Reform League in an attempt to introduce healthier methods of clothing for men on the lines of those adopted by modern women.

Washing of Clothes.

Our clothes become contaminated within and without when we wear them, and should be capable of thorough washing without rapid deterioration. Much has yet to be learnt on this subject. Indeed, there is yet a large field for research in clothing. But it is obviously useless to study the washing properties of the principal clothes of men, which are never washed at all. What would our dress coats and trousers look like if they were white, and we had neglected the wise precaution of having them dyed black so as not to show the dirt? No one to-day would tolerate a surgeon who operated in his ordinary clothes. We expect him, we expect even his historical predecessor, the barber, to wear a white coat which has just been sterilised, and we are right. But we allow the family doctor to go from all kinds of infectious cases to all kinds of other cases in the same coat, which has never been washed at all and never will be. The plain truth is that all the principles of hygiene are outraged by the present clothing of men.

slight yellowing of some artificial silks with age notably reduces the transmission. Artificial silks in general are superior to all other materials in this respect. Their advantage over natural silk is not very large but it is definite, and worthy of consideration in a climate like ours, where the supply of ultra-violet light is so small. Of course this property of any material is irrelevant when it is worn under something else through which no ultra-violet light can penetrate; but it is of value when we have to choose fabrics for stockings, for blouses, and shirts worn for cricket and tennis. But if we are to get any really useful ultra-violet transmission, through whatever material, we must have it white.

In this brief essay on a large and neglected subject, space fails for many topics. I wish there had been room in which to contrast the clothing of man and woman, dancing together any evening anywhere. If either is right, the other is clearly insane. In point of fact, we know that the woman is right.

Ideas of fashion and decency are variable. The principles of beauty remain. To reconcile the claims of health and of beauty in our clothing is not impossible. On the contrary, the wise clothing of a well-formed and well-nourished body is easily harmonised with the beauty of design and colour which fit the living form, the warm tones and the expressive and significant movements of the "paragon of animals."

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XIX
MODERN TREATMENTS
X-RAYS

By PERCY HALL, M.R.C.S., L.R.C.P., Hon. Actino-Therapeutist to the Mount Vernon Hospital.

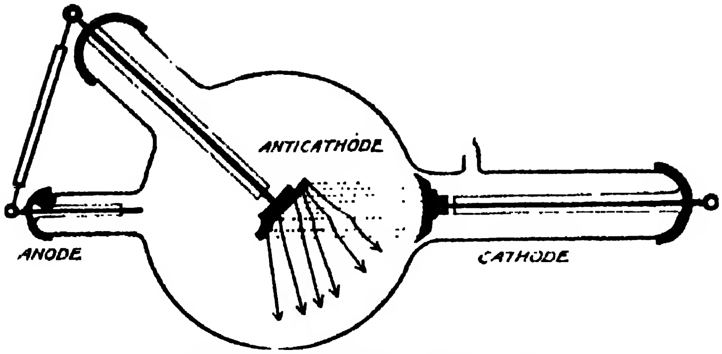
THE original discovery of X-rays was made by Professor Rontgen in December, 1895, when experimenting on the passage of electrical currents through tubes containing rarefied gases. In memory of him, they are often referred to as "Röntgen Rays." The experiments which laid the foundation for this discovery, however, were made at a much earlier date. As early as 1822, certain workers in this field of research were experimenting on the various phenomena produced in glass tubes partially evacuated, and containing two electrodes through which an electrical current passed. Davy, Pflucker and Geissler were amongst the earliest workers in this field. They found that, by passing a sufficiently high voltage current through such electrodes, the sparks emitted could be altered in character, according to the pressure of the gases within the tube. As the gas pressure is lowered, the resistance to the electrical current is lowered proportionately, and it therefore becomes able to bridge a wider gap. Provided that the gas pressure is lowered sufficiently, fluorescence becomes visible within the tube, and a dark patch surrounds the cathode or negative pole. Within this dark and apparently empty patch, Hittorf, in 1869, demonstrated the presence of certain radiations. But little further advance was made until 1879, when Sir William Crookes experimented with these radiations, which he called "cathode rays."

Crookes noted that these "cathode rays" consisted of particles of negative electricity, or "electrons," which leave the cathode at right angles, and take a straight course, at a speed which varies directly with the tension of the current applied to the tube. These radiations, or bands of electrons, are readily absorbed by intervening materials, such as the glass walls of the tube, when by far the greater proportion of their energy is

Courtesy] *[Kodak Ltd.*

UNDER THE X-RAYS

Showing the bony structure of the skate in wonderful detail.



HOW X-RAYS ARE PRODUCED
Electrons given off from the cathode strike the anticathode at high speed, and a small portion of their energy is converted into X-rays (arrows).

converted into heat, the remaining minute percentage becoming X-rays. Röntgen found that when these electrons impinged upon intervening materials, they became the source of new radiations, which produced fluorescence in certain sensitive substances, such as calcium tungstate and barium platino-cyanide, and also affected photographic emulsions in a similar way to luminous light, although invisible to the naked eye. He also noted their effects upon the tissues of the body, and substances such as wood, ebonite, and certain metals. He discovered that these rays penetrated such substances to a varying amount, according to the thickness, density, and atomic weight of the material, and the character of the rays employed.

X-rays can be used for two chief purposes, either for diagnosis, or treatment. In the early stages of their use, they were thought to be of diagnostic value only, their effects upon human tissues being but gradually discovered at a later date.

When X-rays are focused upon a certain material, a proportion of the rays is absorbed, and the remainder passes through almost unchanged. The percentage which is absorbed is now utilised in X-ray therapy, as it produces biological, chemical, electrical and thermal effects in the tissues exposed to the rays. The radiations which pass through the body are used for diagnostic purposes, being passed through onto a photographic plate, or fluorescent screen. The rays pass through in varying amount, the denser portions of the body absorbing more, and consequently throwing shadows which are of diagnostic importance. The quantity of radiation absorbed or transmitted varies according to the quality and quantity of X-rays employed, and can be varied at will.

THE PRODUCTION OF X-RAYS

Apparatus for the production of X-rays can be roughly divided into three parts, viz.: the X-ray tube for the production of the X-rays; the transforming unit which converts the main electrical supply into a current suitable for use in such tubes; and accessory apparatus such as tube stand and holder couch, screening stand, etc., which vary according to the particular use to which the X-radiations are to be put. Of these components, the first two are the essential parts.

In X-ray tubes a high tension current is converted into X-rays. The types of tube

X-Ray Tubes.

in use vary, but are of two chief designs, *i.e.* either "gas" tubes, or "hot cathode" tubes, as they are termed in this country.

Gas tubes are modifications of the original type of tube from which X-rays were first produced. They consist essentially of a spherical glass tube with two ends or "necks" into one of which is sealed the negative pole or "cathode," and into the other the positive pole or "anticathode" Other parts of the tube, such as the anode and the regenerating device, are of chief importance to the manufacturer.

The cathode consists of a concave disc of aluminium carried on an aluminium stem. The "cathode rays," given off when the tube is working, are focused upon the anticathode at a definite angle, from which they are re-radiated. This latter is now generally made of tungsten, which is capable of withstanding the extremely high temperatures generated within the tube when in use. The ends of the tube are connected to a high tension electrical current, and the tube is

evacuated, to a certain extent, of its contained gas. The character of the X-rays produced varies with the degree of evacuation of the particular tube, and the voltage passed through it. When the amount of residual gas contained is large, the X-rays given off are termed "soft," and have but little power of penetration of the tissues, being largely absorbed by the superficial layers. The greater the degree of evacuation, the "harder" or more penetrating do the rays become. With a comparatively low voltage, also, the rays will be of the "soft type, becoming "harder" as the voltage is increased.

Various devices have to be employed to regulate the degree of "hardness" or "softness" of gas tubes, that is to say, the degree of evacuation of the contained gas, and in addition, to cool the anticathode and prevent overheating or even melting of the constituent parts, since over 99 per cent. of the energy emitted is converted into heat.

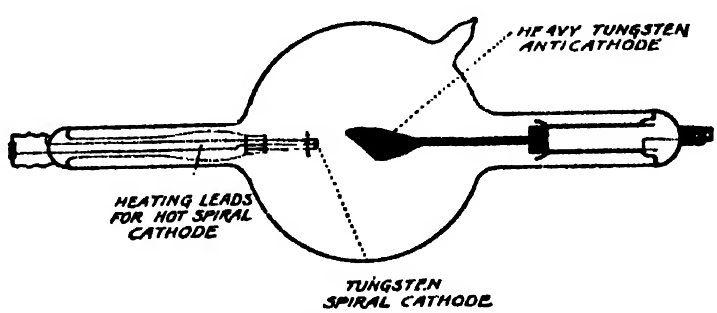
Gas tubes are not entirely satisfactory since the gas pressure continually alters with use, and exact dosage from them is therefore difficult to estimate, and they have to a large extent been superseded in recent years by the more modern types of "hot cathode" tubes. They are, however, still used by certain workers with good effect.

The two chief types of hot cathode tube, viz.: the Coolidge and the Philips Metalix tubes, are fundamentally the same, and differ chiefly in shape, method of protection and mounting. In the Coolidge tube, the cathode consists of a spiral of wire, and the anticathode of a solid block of tungsten, instead of a disc. Before the high tension current is passed through these tubes, a heating current is applied to the cathode, which is heated to a certain definite temperature. It is possible to vary both the voltage and milliamperage of these tubes, and therefore to control the output of X-rays, both as regards their quality and quantity, with greater accuracy than in the older gas-filled tubes. The Coolidge tube is completely evacuated of gas. The Philips Metalix tube, however, contains a small proportion of helium gas after evacuation. This gas offers but little resistance to the passage of the current. Apart from the shape, and the angle of emission of the X-rays produced, these two tubes differ but little in fundamental principles. They are made in various modifications for different purposes, such as dental radiography.

The Philips Metalix tube is covered with protective lead in such a manner as to be self-protected, in distinction to the Coolidge tube, which has to be mounted in protective boxes to avoid dangerous radiations reaching the operator. The supplementary apparatus required with the newer type of tube *i.e.*, the Philips Metalix, is therefore much less heavy and complicated than in the older forms of apparatus. Screening couches and stands, and devices for obtaining exposures of particular parts of the body are very varied in design, and depend upon the uses to which the X-ray outfit is to be put.

The Transforming Unit. The second essential part of an X-ray outfit is the transforming unit, which is required to convert the electrical supply from the main into the high tension current necessary for operating the X-ray tube.

The main electrical supply varies in different districts, averaging about 200 volts, and never exceeding 500 volts. Tensions required for X-ray work, however, are very much greater, varying from at least 50,000



THE COOLIDGE TUBE

The output of X-rays from this tube can be controlled by varying the temperature of the cathode, which is heated by a separate electric current.

volts for diagnostic work, up to even 200,000 volts and more for modern X-ray therapy. Whatever the original voltage from the main, therefore, a transforming unit is required.

High tension generators are of two chief types, the spark coil, or the closed core transformer. Of these, the spark coil was the earliest type used, and is still employed occasionally. It is, however, less easy to manipulate than the more recent types of closed core transformers. The mechanical differences between the two forms are considerable, but the object is the same, that is, to produce a high tension current which applied to the tube will generate X-rays.

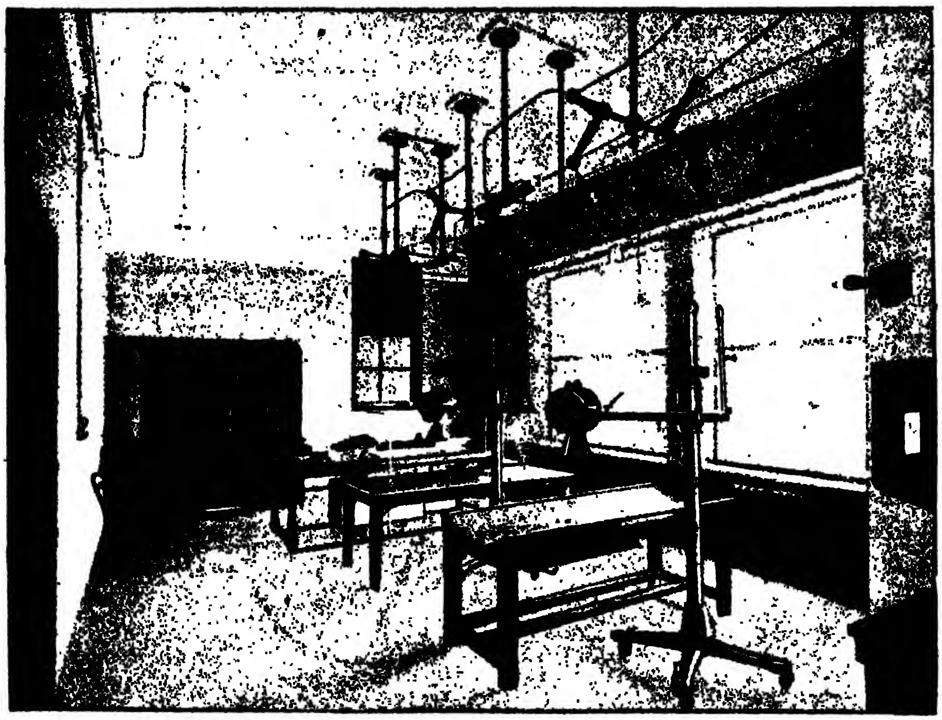
The modern tendency is to raise the voltage as high as possible, as this produces X-radiations of the " hard " or penetrating variety, and obviates the loss of radiations which are absorbed in the superficial tissues of the body, and may lead to changes therein. For therapeutic work, the voltages required are higher than for diagnostic work, such as screening or radiography. It is still a debatable point, however, as to whether very high voltages produce rays capable of better effects than the softer variety.

THE NATURE OF X-RAYS.

Much research has been done since the early days of X-ray work, when these radiations were chiefly employed in diagnosis. Our knowledge of the exact nature and effects of X-rays is still, however, scanty, and much further work requires yet to be done. We now know, however, that X-rays are a form of radiant energy, originally derived from the sun.

The sun gives off vast numbers of radiations, which travel through the intervening ether in waves, differing the one from the other according to their wave-length and periodicity of vibration. These wave-lengths include the luminous band, which we are capable of perceiving and appreciating by the naked eye, and many more rays which are invisible. Amongst these latter are the ultra-violet rays, the infra-red or heat rays, those radiations used in wireless telegraphy and broadcasting, X-rays, and the gamma rays of radium. Other groups of radiations are constantly being investigated, but have not yet been put to either commercial, scientific, or therapeutic uses.

All these radiations are measured in octaves, of which the luminous band represents one octave. Next to this at the violet end of the luminous band are the ultra-violet or actinic rays, beyond them a partially unexplored region, and beyond this again,



Courtesy] [*Watson & Sons, Ltd.*

A MODERN X-RAY DEPARTMENT

A view of the radiographic room at the Royal Infirmary, Edinburgh, showing the apparatus for taking X-ray photographs to aid in diagnosis and treatment.

Keystone

FILMING THE HEART'S ACTION

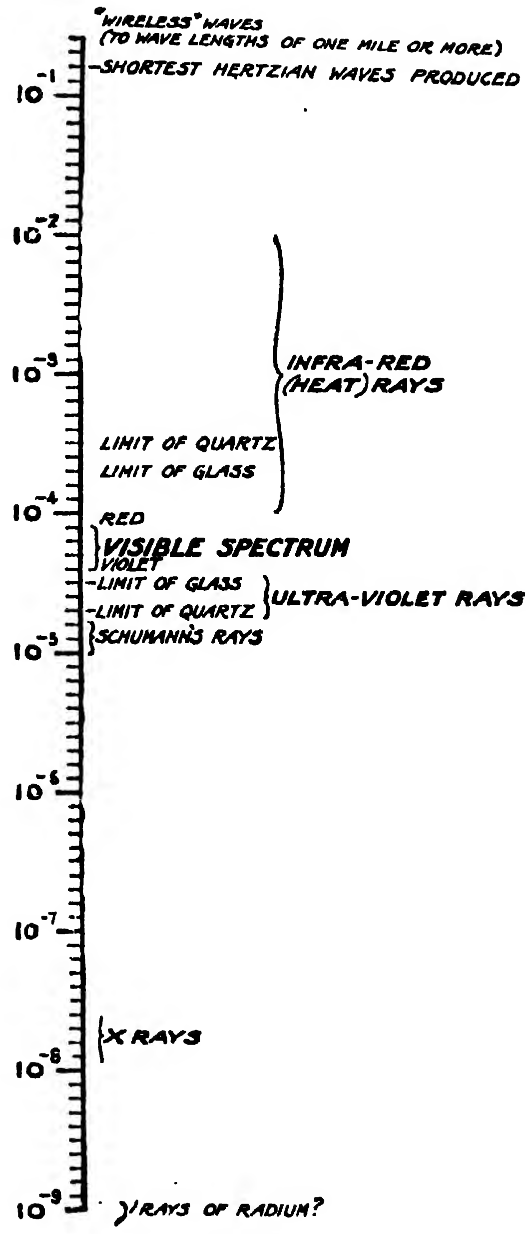
An X-ray cinematograph machine invented in Germany, which enables the doctor to study the organs of the body in motion.

X-rays. The wave-lengths in this direction are gradually decreasing in length, so that the wave-lengths of X-rays are shorter than those of ultra-violet rays, and very much shorter than those of visible light. As the X-rays themselves become shorter, so they become more penetrating, and finally the very shortest rays are followed by the gamma rays of radium, which are also used in the treatment of disease.

Measurements of these radiations are stated in the Angstrom Unit, which is the arbitrary unit of length of the longest or "softest" X-rays. It is one-ten-thousandth-millionth of a metre in length! The "harder" X-rays used in therapy are even shorter than this, whereas the luminous or visible rays range from 3900 to 7500 A U. The rays employed in wireless may even be miles in length.

X-rays exert their effects in two ways, partly by absorption and partly by scattering of the rays. Only those rays which are absorbed into the tissues exert any effect upon them, and the therapeutic uses of radiation are due to this property. The rays which pass through the tissues more or less unchanged have no biological or other effect. For diagnostic purposes, the rays are passed through the intervening object on to a photographic plate or fluorescent screen. The resulting picture depends for its detail upon the quantity of radiation, and its quality. When "soft" rays are passed, a detailed picture results, as even the less dense structures, such as the flesh of the body, absorb a sufficient quantity to throw a shadow on the plate beyond. Bone and similar structures, being denser, throw more definite shadows, and consequently a well-defined picture of the component parts is produced. When the rays are mostly "hard" they pass through the tissues with more penetration and less absorption, and the resulting picture is less detailed.

For therapeutic purposes, when it is desired to treat parts of the body some distance from the surface of the skin, it is



THE SPECTRUM

Showing the place of X-rays in the wide range of wave-radiations which differ only in wave length.
(10^{-1} $^1/_{10}$ cms.; 10^{-2} -- $\frac{1}{10 \times 100}$ ms., etc.).

necessary to filter out the softer rays, which would otherwise produce effects upon the superficial tissues, which might be dangerous, whilst the underlying parts might not receive an adequate dose. This is done by means of filters of various metals and thicknesses, which are interposed between the source of X-rays and the beam of light. These serve to filter off the softest rays, whilst allowing the more penetrating rays to reach the part. By the application of filters of varying thickness, made of either aluminium or copper, it is possible to radiate tissues some distance from the surface of the body without affecting the skin adversely. The doses required to produce constitutional effects are so much greater than those needed for diagnostic purposes that the brief exposures used in radiography produce no obvious results upon the patient. The operator, however, has to be shielded from continuous or repeated short exposures even to minute doses, as a cumulative effect is produced. That is to say, even tiny doses, if often repeated, may produce ill effects after a period of years. This was not known in the early days of X-ray work, and early workers in this field suffered severely from the effects of repeated exposure. With modern methods of protection of the operator, these risks have been almost entirely overcome.

TREATMENT BY X-RAYS

Radiotherapy, or the treatment of disease by X-radiation, is a comparatively new science, but one which offers wide possibilities for future development. The most popularly known use for X-rays is in the treatment of inoperable cases of cancer. Although this is a field which is yielding excellent, and improving results, it is not by any means the only one. Many skin diseases yield to X-radiation, often in combination with other remedies such as ultra-violet radiation. Lupus, and certain other forms of tuberculosis, can often be treated successfully. Hodgkin's Disease, a condition in which various glands of the body enlarge, producing pressure symptoms and often death, is well treated by this means. Malignant disease of many forms yields to it, even if "cure" is not always obtained the patient often lives for a longer period and in greater physical comfort than would otherwise be the case.

The combined use of operation and radiotherapy, either pre- or post-operative, offers perhaps the best results, as a previously

inoperable growth may shrink sufficiently to allow it to be surgically removed.

In skin diseases, X-rays are useful, since they exert profound effects upon superficial tissues. In suitable doses, the hair can be made to fall out, and will return later. This fact is employed in the treatment of that otherwise resistant disease, ringworm of the scalp. If an overdose is given, however, permanent baldness may result, owing to the atrophy of the hair follicles produced. Disasters of this kind were comparatively common in the early days of X-ray therapy, but with improved technique and standardisation of dosage, they seldom occur now.

X-rays produce, in sufficient quantity, an erythema or redness of the skin. This is not manifested until some weeks after the dose has been given, and varies according to the amount of the dose. A severe erythema is never produced deliberately, as it may be followed by sloughing of the tissues, and the production of what is termed an "X-ray burn." Such burns are extremely intractable, and resistant to treatment, and are often followed by cancerous changes. The pioneers in this form of treatment did not realise these dangers, owing to the slowness of this manifestation, and suffered mutilation and deformity in consequence.

X-rays also exert effects upon the blood, and are used in the treatment of certain diseases of the blood or blood-forming system. The red blood corpuscles are diminished in number and anæmia may result after prolonged and excessive dosage.

The term "deep therapy" was originally applied to X-radiation designed to reach organs situated deep within the body. Massive doses were employed for their destructive effect, generally for malignant disease. The results varied in different hands, but on the whole, the constitutional effects simultaneously produced were so severe that this method is not used to any great extent, at least in the form in which it originally appeared.

Thus, broadly speaking, X-rays are employed in therapy for two chief purposes, either stimulation, as of the superficial layers of the body, or destruction of deep-seated growths.

Dangers of X-Rays.

The dangers associated with the use of X-rays have been indicated, but may be broadly grouped as immediate and remote.

The immediate dangers are those encountered during an actual exposure, and are due to the passage of high tension currents to the tube. Contact with a high tension lead carrying 100,000 volts of current will produce an electrical shock which may, and has been known to, produce immediate death. The newer forms of apparatus guard against this contingency to a large extent, but reasonable care has still to be exerted by the operator.

The remote effects are those due to the effects of absorption of X-rays by the tissues. These do not manifest themselves for days or even years after the exposure, or series of exposures. If the actual exposure is too large, X-ray burns, warts, and cancerous growths may appear later. Telangiectasis, a condition in which the blood vessels of the skin become dilated and prominent, may develop. Owing to the cumulative effect of radiation, even tiny doses, if the sum total is too great, may lead to these ill effects. Anæmia, sterility, and other constitutional changes may also occur, particularly in operators who are constantly exposed carelessly. Generally speaking, however, with modern modes of application and protection, the dangers of X-rays are rapidly becoming a thing of the past, whereas their benefits and scope are constantly increasing, and they will doubtless play a much greater part in the medicine of the future.

It must be remembered that X-rays are but one form of radiant energy. Different forms may be used in conjunction or sequence, and by this means their effects may be modified or complemented. For example, it has been found that a preliminary dose of ultra-violet rays facilitates the passage of X-rays, and therefore renders a skin "burn" less likely. Indeed, ultra-violet radiation has been successfully used in the treatment of old-standing X-ray burns.

The author has had several astonishingly good results in cases where the X-ray burn has led to ulceration and the beginning of cancerous changes.

X-RAYS AND THE DETECTION OF DISEASE

By ALFRED C. JORDAN, C.B.E., B.A., M.D., B.Ch., D.M.R.E., M.R.C.P., formerly Medical Radiographer to Guy's Hospital and The Royal Infirmary for Diseases of the Chest.

No discovery in modern times has been more sensational or fraught with more important consequences than that of X-rays. At once the new rays were pressed into the service of medicine. Crude and weak as was the apparatus for producing X-rays, and little as was then known of their properties, nevertheless they were used forthwith for the diagnosis of fractures and dislocations; for locating bullets, needles and other metallic foreign bodies in the tissues, and also for detecting swallowed coins or other dense substances in the food-pipe, the stomach, or the intestines.

Having familiarised themselves with the X-ray appearances of the bones and joints in health, surgeons soon found they could recognise changes in structure and outline caused by disease, so that different diseases of bones and joints could be diagnosed by their X-ray pictures.

The slender bones of the hands were the easiest to study, but as apparatus improved, the larger limb-bones and joints were successfully tackled; then the spinal column which required special posturing (oblique views, etc.), and lastly, the skull with its thick cranial bones and the complicated structure of the facial skeleton. By this time it had become obvious that few surgeons or physicians could be expected to master all the details of structure of the many bones and joints that make up the skeleton, so as to distinguish changes due to disease from normal variations and at the same time make themselves familiar with the construction and working of the apparatus—steadily becoming more complicated and powerful. A new specialism arose to meet the new need and the number of radiologists increased steadily as the use of X-rays extended.

Stones in the kidneys and bladder (and occasionally in other organs) may contain enough lime salts to render them as dense as bone; they can then be revealed in an X-ray picture. The diagnosis of calculus (stone) requires care and expert knowledge and experience, since calculi may be mistaken for other concretions within the body some of which are of little consequence; these include calcareous (chalky) deposits in abdominal lymphatic glands, concretions in veins, etc.

So powerful an agent for evil might, under proper control, become an agent for good and at once attempts were made to apply X-rays in the treatment of various chronic skin diseases; some highly favourable results were obtained; even skin cancers could be made to disappear in certain cases. Hopes ran high that a "cure" for cancer had been discovered, but although these hopes have proved elusive, even with the enormous powers now available, X-ray treatment is still largely applied for the partial relief of cancer sufferers; radiologists are continuously striving to improve their technique so as to obtain better results.

In certain skin diseases, measured doses of X-rays are efficacious. The X-ray treatment of ringworm depends on a property of the X-rays—discovered accidentally in the early days—of causing the hairs to fall out over an area of skin (*e.g.* scalp) two weeks after exposure of the area to an appropriate dose of X-rays. After six weeks, the hairs begin to grow again, and if, in the meantime, the bare scalp has been rendered healthy by local applications, the new hairs are healthy and free from ringworm fungus. An overdose of X-rays causes permanent baldness; an underdose fails to produce complete depilation.

Great is the temptation to employ X-rays for the removal of superfluous hairs, *e.g.* on women's chins, but to produce a permanent result, an overdose must be given, so as to cause some degree of dermatitis; this may

[Central Press.

X-RAY TREATMENT IN PROGRESS

The patient is protected from the powerful rays with sheets of lead and only the area to be treated is exposed.

lead to a disfiguring scar or a patch of skin scored with unsightly blood-vessels—results far more distressing than the unwanted hair.

The Heart and Lungs.

Early in the history of X-rays, it was found possible to obtain pictures of the heart and great blood-vessels, these organs (with their contained blood) being dense enough to show "up" against the air-filled lungs which surround them. To-day, the X-ray examination of the chest adds greatly to the accuracy of diagnosis of diseases of the heart and great vessels.

The lungs, too, are found to yield up many of their secrets to the penetrating rays; no physician, now would be satisfied with his examination of the lungs until he had used the X-rays to confirm and control his physical examination of the chest; nor would he fail to repeat the X-ray examination at intervals to check progress.

Pulmonary tuberculosis is, of course, the chief lung disease—though by no means the only one—for which the X-rays are used regularly; every sanatorium has an X-ray department as one of its most essential constituent parts.

The Digestive Organs.

The last—though in many ways the most important—system of the body to be brought under review by the X-rays was the digestive system, consisting of the œsophagus (food-pipe), the stomach and the intestines. These are thin-walled, hollow tubes which throw no visible shadow on the X-ray screen. To show them, it is necessary to fill them with dense material so that their form may appear as dark shadows in the X-ray picture. The substances most used for the purpose are the insoluble salts of bismuth and barium. These salts can be swallowed in large amount, mixed with food, or in watery suspension,

and the progress through the digestive canal watched in all its stages. They can also be introduced into the lower bowel as enemata. The dense salts mix with the contents of the stomach and intestines (the digesting food and the intestinal juices) and enable the radiologist to follow the entire process and ascertain the size, shape, and position of every part of the digestive tube. He sees the various organs at work ; watches the peristaltic waves by which each part sends on its contents into the next part and notes features that are unusual or abnormal ; here experience of many observations comes to his aid and it is in this department of radiology more than any other that expert specialism is essential for correct diagnosis.

When X-rays began to be used for the diagnosis of diseases of the digestive organs, the method used was, naturally enough, to consider diseases as they were arranged in text books and affix labels to the X-ray pictures that would fit in with the text-book arrangement. Thus there were diseases of the stomach, of the duodenum, the appendix, the several portions of the large intestine, and so forth.

A radiologist who discovered an ulcer of the stomach, or of the duodenum, for instance, was very well pleased to have made a definite diagnosis of a text-book disease, and the surgeon or physician in charge of the case was equally satisfied. There is no "getting away from" the X-ray demonstration of an ulcer or a growth in the stomach, of an appendix that is anchored, or a bowel that is kinked and obstructed. The more enterprising radiologists, however, were not content to confine their observations to the X-ray room, but took every opportunity of controlling their findings by visits to the operating theatre, whenever it became necessary for the surgeon to intervene.

It became clear—though unsuspected previously—that there was *no such thing as disease of a single organ*, all others remaining healthy. The reverse is the fact : *all* the organs and tissues—the entire organism, in fact—is out of gear before a particular organ, such as the duodenum or the appendix, "gives out" and becomes the seat of a "text-book" disease. The X-ray investigation demonstrates this unmistakably. The so-called "disease" is, in reality, an end-result, even though the patient and perhaps his medical attendant had no suspicion of the trouble that was brewing.

Beginnings of Disease.

Obviously it is bad policy and poor medical practice to allow disturbance to grow into disorder and disorder into disease before taking preventive steps. To obviate this happening is the true function of radiology.

The intestines act best when they are of a particular size and length and so disposed in the body that they can perform their functions to advantage. Excessive length or drooping need not be a bar to efficient function, but is very apt to become so. Thus, an unduly long loop of bowel is liable to turn on its axis and become partially obstructed ; a portion that hangs too low may adjoin an anchored portion, the result being sharp angulation, and—again—partial obstruction. Either of these causes of obstruction involves stagnation of contents ; stagnation means decomposition. Microbes are always at work in the large intestine ; in health, their activities are beneficent ; they break up the cellulose walls of vegetable cells (taken as food) and enable the digestive juices to act upon their nutritious contents. In a stagnant bowel, however, some of these microbes multiply enormously and take on virulent activities, creating poisons which pervade the system and rot the lining membrane of the bowel and eventually the entire thickness of the bowel wall with its important systems of muscles and nerves.

Stasis.

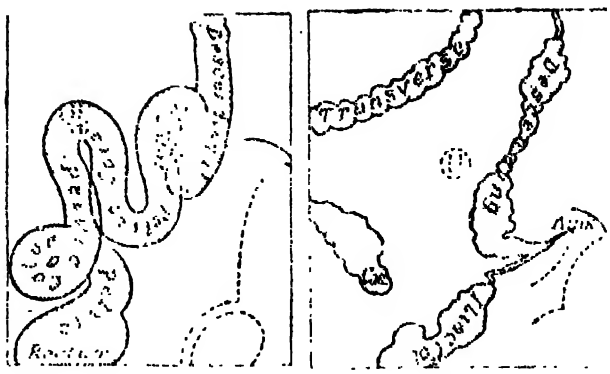
There are medical observers who do not believe in the importance of this microbic poisoning. They say : "The intestines are endowed with a special system of veins—the portal system—whose duty it is to carry to the liver the products of intestinal digestion. The liver is quite capable of dealing with the poisons that reach it." There are two replies to this : Firstly, the liver is able to deal only with a

limited amount of microbic poison; in stasis (stagnation in the bowel) this limit is soon passed; not only do the poisons then pour into the blood-stream, but they flood the liver itself and disorganise it, impairing its efficiency for its many functions.

Secondly, there is a point apt to be overlooked, viz.: that some of the products of intestinal digestion escape the attentions of the liver because they do not enter the portal system at all. There is a lymphatic system of vessels that drains the entire length of the intestines and carries fluid that may be teeming with microbic poisons straight into the blood-stream by way of the thoracic duct (the largest lymphatic vessel) which opens into a great vein close to the heart. The fluid enters the right side of the heart together with the venous blood, is carried into the lungs to be aerated, is returned to the left side of the heart and conveyed thence into the general system of arteries, carrying all the poisons with it, to reach every organ and tissue of the body. To allow microbes to pour their poisons into the intestines is to court disaster.

Naturally enough, the more extreme and urgent cases were the first to come under observation, and the important fact was revealed by the X-ray and confirmed at operation that most of the text-book diseases of the digestive tract were, in reality, end-results of stasis. That is to say, although only a single organ had actually broken down, there were widespread changes of structure and function throughout the digestive tract.

Briefly, these changes consist in (1) drooping and other changes of position; (2) elongation; (3) fixation of the bowel in certain regions, with consequent kinking at the fixed points; (4) congestion, catarrh or erosion of the lining membrane of the bowel, due to stagnation and decomposition of its contents; (5) spasmodic constriction of long stretches of the big bowel, due to the irritated state of its lining membrane; this has the effect of imprisoning the stagnant contents in the bowel further back; the bowel is



EARLY DIAGNOSIS BY X-RAYS

Drawings taken from X-ray photographs of the abdomen, showing distortions of the intestines which will result in disease *left*, a great elongation of the big bowel, *right*, a sharp kink.

never able to clear itself properly, so the condition of poisoning goes from bad to worse, until, sooner or later, the dreaded breakdown of one or more organs takes place.

Patients do not always go to their doctor for advice when their health begins to fail, or when they notice the first onset of some unpleasant symptom. Instead, they persuade themselves it is but a passing indisposition that will clear up of its own accord. Too often, however, these early symptoms are, in reality, nature's warnings that all is not well with the tissues; they are the symptoms which Sir James Mackenzie studied so diligently. If, at this early stage of disease, an X-ray investigation be carried out, an accurate account is furnished of the condition of every part of the digestive system; thus a certain clue is given to the character of the early disorder which is causing the symptoms, and to the lines of treatment best calculated to put things right and restore the patient to safe and sound health. Without the aid of the X-rays, the doctor and his patient must remain, to some extent, in the dark and there is a danger that the disorder may go on to the late stages when one or other of the breakdowns occur, such as a definite lesion (*e.g.* an ulcer) of an organ, necessitating a long term of incapacitating illness, or a more or less hurried resort to surgery. Nearly all these tragedies could have been prevented, had the unhealthy condition of the tissues been

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HOW THE INTERNAL ORGANS ARE PHOTOGRAPHED

An X-ray photograph showing the large intestine which has been rendered opaque to X-rays by a "barium meal"

happening at the *roots* without X-ray films; these give sharply-defined pictures of the teeth and reveal at once any infection at the roots. It might be thought that a tooth with an infected root would give so much pain that its owner would insist on its removal without waiting for X-ray films. This is not the case, however; very often an infected tooth is a "dead" tooth; its nerve has been deliberately killed and extracted at some previous time by the dentist, to enable him to clear out the decayed pulp and insert a filling. Such a tooth—and similarly a crowned tooth—may remain useful and harmless for a number of years, but eventually its roots are almost certain to become infected and set up constitutional troubles, such as rheumatism. It is wise to regard any crowned or "dead" tooth with suspicion after ten years, even if no rheumatic or other symptoms have thrown suspicion upon it previously.

The use of opaque substances has brought many other regions within the scope of accurate X-ray diagnosis. A

Opaque Injections

"dye" (sodium tetra-iodo-phenol-phthalein), when injected into a vein, or swallowed in capsules, passes into the liver and thence into the gall bladder. The dye is opaque enough to give a shadow of the gall bladder and enable gall-stones (which are not opaque to X-rays) to be revealed as clear areas. If no dye enters the gall bladder, it is presumed that the entrance to it is blocked by disease or by a gall-stone.

discovered in good time, and corrected by appropriate treatment.

Let it not be supposed that the X-ray investigation is the only one that is necessary or helpful; other tests—biochemical and bacteriological—are very helpful, both in diagnosis and in treatment; none, however, is so graphic and decisive as the X-ray.

A fairly recent development of X-ray diagnosis concerns the teeth. A dentist can

Dental Radiography.

tell, by inspecting the mouth, what is wrong with the crowns and necks of the teeth and with the gum margins, but he cannot see what is

Another heavy substance, lipiodol, is injected into cavities in various parts of the body, to give an outline of these cavities; it is used, for instance, for the exact diagnosis of cavities in the lungs, for the central cavity of the spinal column, for tracing the course of a sinus leading to a source of suppuration and so forth.

Prophecy is always hazardous, but the reality has often proved more wonderful and sensational than the imaginings of the prophets. And so it may be with the X-rays. In the thirty-five years since their marvellous properties flashed upon an astonished world, surprise has followed surprise. It will be strange indeed if the next thirty-five years fail to furnish new revelations of the properties of the rays and the part they play in the universe; while, on the physical side, there seems no limit to human ingenuity and skill in devising new appliances and interpreting new phenomena.

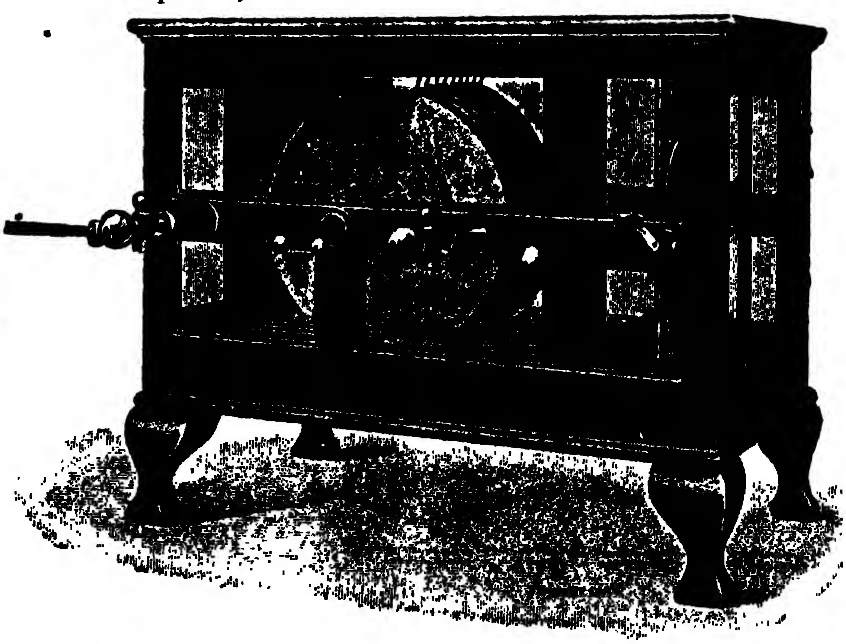
The Future.

MEDICAL USES OF ELECTRICITY

By ALFRED C. JORDAN, C.B.E., B.A., M.D., B.Ch., D.M.R.E., M.R.C.P., Formerly Medical Radiographer to Guy's Hospital and The Royal Hospital for Diseases of the Chest.

SOON after Galvani made his classical discovery of the action of electric currents on muscle and nerve (about 1760) electricity was used for the treatment of all manner of complaints. Its use, however, till recent years, had been purely empirical and many of the successes gained were the result of "faith" rather than any actual remedial virtues of the electric current; the consequence was that electrical treatment got into the hands of "quacks," who exploited these "faith cures" to their own great pecuniary advantage; and so electrical treatment fell into disrepute among medical men. During the last thirty years, however, the study of electrical action has been taken up by men of high medical and scientific attainments, and to-day medical electricity has a useful and honourable place among the resources which medical men are able to place at their patients' disposal.

The two chief uses of electricity are for diagnosis and treatment. Electrical Diagnosis depends on Galvani's original experiment with the isolated muscle and nerve of a frog. When the nerve was "stimulated" by an electric current, the muscle contracted; if the nerve were injured so that it could not convey impulses, the muscle failed to contract, but if the muscle itself were stimulated, it might contract, provided the nerve-endings in the muscle were still healthy. This electrical stimulation is used in the



Courtesy] [Watson & Sons, Ltd.

A STATIC MACHINE

The interrupted currents produced by machines similar to this are specially suitable for their stimulating effects in rheumatism and partial paralysis.

diagnosis of various forms of PARALYSIS. Two kinds of current are needed: continuous (direct), and interrupted. A healthy muscle and nerve responds to both kinds of stimulation; Faradic (interrupted) current causes a healthy muscle to contract while the current is maintained; Galvanic (continuous) current causes a contraction at the moment the current is "made" or "broken." In certain paralytic diseases, the "reaction of degeneration" is shown by a complete alteration of these responses: Faradic excitation no longer causes any response, while Galvanic stimulation causes (in early stages) an increased response and an alteration in the nature of the response.

Another diagnostic use of Faradic stimulation—of rare applicability—is in localising brain lesions when the surface of the brain is exposed by accident or at operation. Electrical stimulation of certain areas of the brain's surface produces definite results—movements of limbs, etc.

TREATMENT by electrical methods may be directed (1) upon the disease, to destroy tumours or to check infections; (2) upon symptoms, to give relief (in conjunction with other methods of treatment).

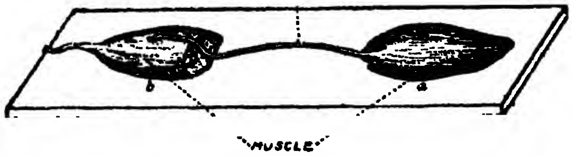
Pure water is a non-conductor of electricity. Water containing a salt in solution conducts

Mode of Action.

electricity. A solution, say, of common salt (sodium chloride), contains numbers of "ions" or electrified atoms of sodium and chlorine, moving freely through the liquid in every direction. If an electric current is passed through the liquid, the movements of the ions are directed toward the poles; the sodium ions (which carry a positive charge) toward the negative pole; the chlorine ions (negatively charged) toward the positive pole. The electric current consists of these two streams of ions, with opposite charges, moving toward opposite poles. At the terminals, caustic soda and hydrochloric acid are formed—one at each. Both substances are caustic and destroy tissues if kept in contact with them. If, instead of a solution of salt, the electric current is made to pass through living tissues, these two caustic substances can be made to damage or destroy tissues near the poles. In the case of diseased tissues, this action may be a valuable method of treatment. The terminals may be made of special chemical substances, such as zinc or salicylic acid, and ions of these substances may be made to penetrate into the tissues for a short distance. This is known as ionisation or "iontophoresis." Part of the good effect of this method is due, no doubt, to dilatation of blood vessels giving an increased blood-supply to the part, and to other reactions set up in the body by the unaccustomed stimulation.

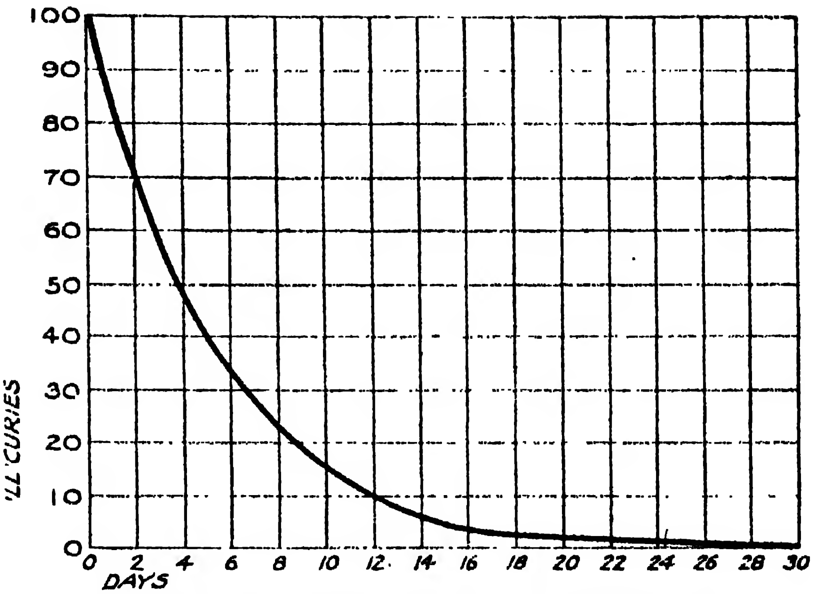
Continuous currents and interrupted continuous currents are used for their chemical and their general stimulating effects, in various rheumatic disorders. If there is stiffness or partial paralysis, strong stimulation, oft-repeated, may gradually restore the muscle to a stronger state; it may even be possible to produce muscular contractions powerful enough to break down adhesions—in the manner practised by osteopaths—and release stiff joints or rigid portions of the spine. The static wave current, produced by a big static machine, such as a Wimshurst or Holtz, is the best for this purpose; it gives an interrupted continuous current which produces powerful muscular contractions with less pain than that derived from batteries or dynamos.

The chief forms of alternating current used for treatment are derived from induction coils (Faradic current) and from dynamos (sinusoidal current). Various couches, baths, etc., are in use for the application of the several forms of treatment to render them as effective and as pleasant as possible.



GALVANI'S EXPERIMENT

The basis of electrical diagnosis—"stimulation" of uninjured nerve attached to the isolated muscle of a frog causes the muscle to contract, and the contraction can be conveyed from *a* to *b* along the nerve to a second muscle.



THE RATE OF DECAY OF RADIUM EMANATION
Radon, the inert gas which emanates from radium and is largely used in treatment instead of the element itself, diminishes rapidly in radio-active power.

Diathermy. In addition to the chemical and stimulant effect of electricity, there is another, of more recent introduction, and of great importance, viz., the HEATING EFFECT. When an electric current passes through an imperfect conductor, heat is generated in proportion to the resistance offered. Living tissues are not good conductors and offer considerable resistance; consequently they become heated when electric currents are passed through them. However, the currents that have been considered so far are not strong enough to produce any important rise of temperature; a different type of current must be used. This is the high frequency current, produced by the discharge of high-voltage current across a spark-gap. When a Leyden jar or other condenser is discharged, the bright spark which leaps across the gap consists of a series of rapidly oscillating discharges which reverse their directions many thousands of times a second. There is no time for any chemical action to take place. Very much more powerful currents can be passed through the body using these high-frequency discharges than could possibly be tolerated or used with Galvanic or Faradic currents. In this way, pronounced heating effects can be obtained and can be directed, at will, to deep-seated parts as well as to the structures near the surface of the body. Special apparatus has been devised, and gradually perfected so as to give sustained oscillations.

In many maladies (too numerous to name here) a moderate rise of temperature is a useful therapeutic measure, and the diathermy apparatus is the best (maybe the only) method of producing it.

SURGICAL DIATHERMY is a far more drastic use of the high-frequency current: to raise the temperature of diseased tissues so high as to destroy them. Growths both simple and cancerous may be destroyed by this method. The growths must be fairly near the surface, for instance, in the mouth or throat, for this method to be applicable. In many cases (for instance, cancer of the tongue) it is preferred to surgery, though diathermy is now being superseded by radium treatment for many growths.

RADIUM AS A CURATIVE AGENT

By ALFRED C. JORDAN, C.B.E., B.A., M.D., B.Ch., D.M.R.E., M.R.C.P., Formerly Medical Radiographer to Guy's Hospital and The Royal Hospital for Diseases of the Chest.

THE X-rays were discovered by Professor Röntgen in 1895. Next year (1896), Becquerel discovered that similar rays were emitted by uranium compounds. Pitchblende, the chief uranium ore, was found to emit more rays—*i.e.* to be more radio-active—than its uranium content could explain; it must contain some other

[Keystone

RADIUM IN THE CURE OF CANCER—I.
A patient receiving radium treatment for cancer behind the ear.

substance, more radio-active than uranium. To discover this substance, Madame Curie carried out a painstaking research which culminated in the separation from tons of pitchblende of a few grains of a highly radio-active substance. She had, in fact, discovered radium.

Radium is a heavy metal ; its salts are as radio-active as the metal ; rays are given out continuously, and the rate of emission cannot be modified by any known chemical or physical method. Three kinds of " ray " are emitted : Alpha rays, which are positively electrified atoms of helium ; beta rays, which are negatively electrified particles, or electrons ; and gamma rays, which are similar to X-rays in all respects, but are far more penetrating.

At the time that radium was first isolated, the power for evil of the X-rays was already known, and their possibilities for good were being tested—and proved in certain instances. Radium " burns " were soon experienced by those rash enough to carry a glass tube containing a radium salt in the trouser pocket. (This occurred to Monsieur Curie himself.) These burns were almost exactly like those produced by too long an exposure of the skin to X-rays. The curative possibilities of radium were then tested, and it was found that certain growths of the skin, whether simple or cancerous, melted away under its influence, just as with X-rays, though even more quickly and more certainly, provided the amount of radium was sufficient.

This proviso has stood in the way of the full exploitation of radium as a curative agent. Radium is so precious, and its extraction from tons of pitchblende is so tedious and expensive that the world supply has remained far behind the need ; moreover, much of this meagre supply has been in the hands of private persons and small institutions, where it could not be put to the best possible use. Now, at last, fairly adequate amounts of radium have been collected in suitable places, where its medical uses have been studied and worked out systematically. Foremost of these places are Stockholm and Paris.

The gamma rays are used almost exclusively. They are derived, either from radium

Radium Emanation.

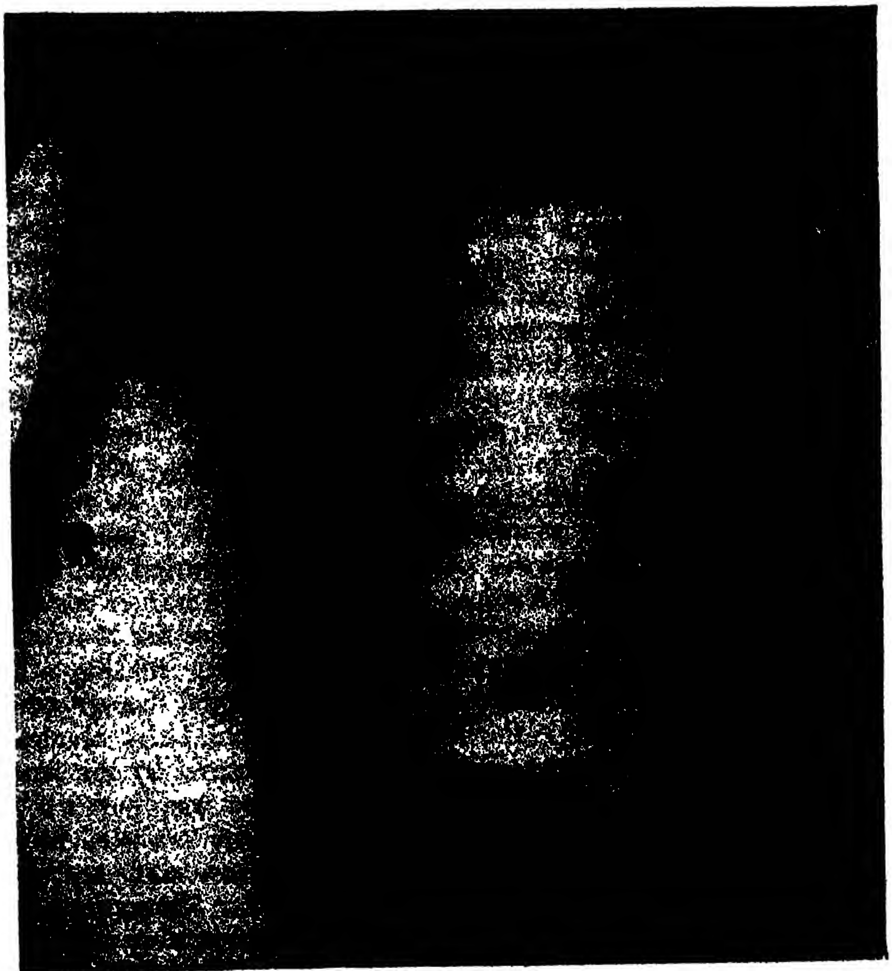
itself (or rather from one of its salts), or from "radon" or radium emanation. This is a gas that is emitted from radium continuously at a constant rate and can be collected in glass tubes and sealed up in any desired amount. Radon is itself radio-active, but differs from radium in that its activity diminishes or "decays" according to an exponential law; that is to say, at the end of four days (nearly) its radio-active strength is reduced to one-half; after a further four days, to one-half of this—*i.e.* one quarter, and so on. Practically it amounts to this, that after six days or so, a tube of radon has become valueless. But the whole of the original stock of radium from which it was drawn is still available in undiminished amount and strength, and will go on yielding radon at the same rate for an indefinite number of years without perceptible loss.

Radon "seeds" are enclosed in sheaths of platinum or other metal for inserting into growths. If they should be lost, no great harm is done, whereas the loss of a needle of actual radium is a very serious matter.

The present writer was the first to use radium emanation in sealed tubes for treating cancerous growths—twenty years ago (*Lancet*, Nov. 11th, 1909). Even the small amounts then available showed a remarkable power of destroying cancers, in the floor of the mouth, the side of the tongue, the neck of the womb, the interior of the lower bowel. But the radon tubes were too feeble to reach and destroy the outlying cancer cells, and although the centre of the growth disappeared, the periphery went on growing.

At the present time, a number of radon "seeds" or radium needles are placed within the growth all round its growing edges where they have the best chance of destroying the young growing cells and preventing the outward spread of the disease.

Till the present decade, all cancerous growths (except a few on the surface of the



Courtesy] [" *Radium and its Surgical Application*," *H. S. Souttar* (*London: Wm. Heinemann* (*Medical Books*), *Ltd.*)

RADIUM IN THE CURE OF CANCER—II.

An X-ray photograph showing two methods of inserting radium to cure cancer of the breast: radium needles, which are withdrawn after some days, and radon seeds, which need not be removed.

Courtesy] [Dr. A. C. Jordan.

AN ULCER CURED BY RADIUM

A case of ulcer of the eye (*left*) before, and (*right*) after successful treatment by radium.

Radium Versus Surgery.

body) were dealt with by the surgeon, and if brought to him early enough, a fair proportion were removed completely and did not recur. Too often, however, local recurrences took place, or dissemination in distant parts of the body. So seldom was a definite "cure" obtained that surgeons found themselves removing growths more and more widely until cancer operations had become terribly mutilating. But still recurrences were the rule. Then, but not till then, the radiologist was called in ; too late to hope for anything better than some relief of pain and some temporary diminution in the size of the growth. Some surgeons then decided to give radiation first chance ; at any rate it would reduce the size of the growth and make its surgical removal easier. Radium treatment has gained ground, and to-day it has established its place as the best means of treatment of cancer in certain situations : the tongue ; the throat ; the breast ; the womb ; the rectum. Radium treatment is painless and saves patients from dangerous mutilating operations with tedious recoveries and—in many cases—horrible disfigurement.

In the Munich women's clinic, no cancer of the womb has been treated by operation since 1913. In Stockholm, since 1920, nearly all cases of cancer of the womb have been treated by radium. The tongue and the breast, too, have been rescued from the surgeon.

Some internal growths are so deeply-seated that radium needles cannot be inserted into them until a surgeon has opened up the way. This "surgery of approach," however, is a very much milder measure than the attempted *removal* of a deep-seated growth.

Early Diagnosis.

Nearly always a cancer starts as a small local growth ; obviously this is the time to "catch" it ; if allowed to grow, it invades neighbouring structures, spreads widely and eventually becomes disseminated. No treatment can then be expected to prevent the fatal outcome. *Early diagnosis* is everything. Radium treatment has made early diagnosis easier. Hitherto many patients have kept their suspicions to themselves for fear of a mutilating operation. Now it is known that radium treatment is painless, non-mutilating and more certain than operation, there is no need to fear a thorough examination.

Radium Versus X-Rays.

The chief advantage of radium over X-rays for cancer treatment lies in the ability to place radium actually in contact with the tumour cells, whereas X-ray treatment has to be carried out from a distance. Where a large surface requires irradiating, there is a chance for X-rays. But even here, radium is now making a bid to supplant X-rays. Several four-gramme "bombs" of radium have been obtained (one has just been secured by the National Radium Commission and installed in a London hospital) : these are used in the same way as X-ray tubes, and are probably more effective, since the gamma rays of radium are more penetrating than the X-rays.

The initial cost of radium is immense ; once acquired, however, its powers remain unimpaired for an indefinite number of years. The important matters are that the radium should be accumulated where it

can have safe storage, skilful handling, be available *all the time* for treatment of patients by medical men who have made a special study of the subject and gained wide experience in its uses. The whole of the radium should be in use day and night without cease. Physicists must work in conjunction with the medical staff, collecting radon, sealing it in "seeds," measuring doses, and so forth.

Prevention or Cure?

When all has been said that can truthfully be urged for radium as a "cure" for cancer, the fact remains that at present—less than half the cases can be described as "apparently cured. Sixty per cent. still end fatally sooner or later. Prevention is still—and must always remain better than cure. And the prospects of preventing cancer, or, at any rate, of preventing a great deal of the recent increase in its incidence, are quite good.*

To conclude, it is possible to look forward to a time in the near future when most cancers will be prevented by correct methods of living; and most of the remaining non-preventable (or at any rate non-prevented) cancers will be successfully treated by radium.

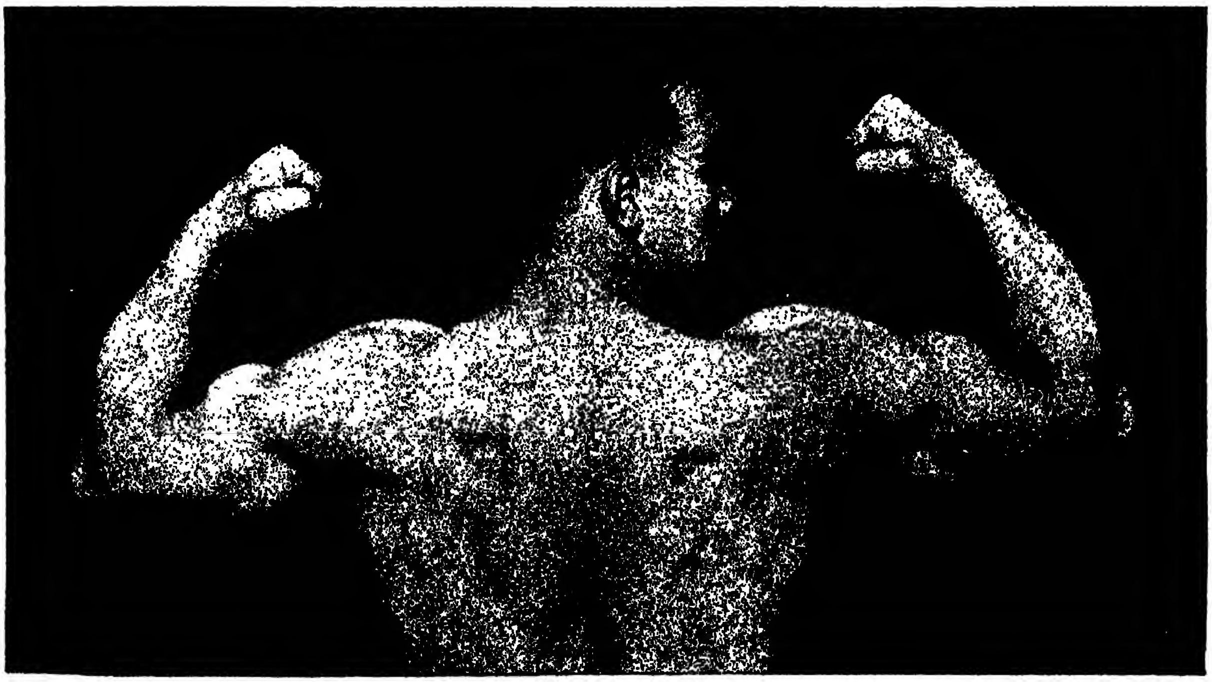
* See *The Prevention of Cancer*, p. 851.

HEALTH EXERCISES

By F. A. HORNIBROOK, author of "The Culture of the Abdomen."

IN modern civilised Europe many different systems of exercises have been evolved—most of them spun out of the thoughts of theorists rather than deduced from the facts of life. Thus come many vain imaginings—*e.g.*, that national games keep the nation "fit," even though only a tiny fraction of the nation plays them actively. Similarly, men like playing golf, and so they allege that playing golf keeps men fit. Yet we all know many golfers with sagging, overloaded bowels and slack abdomens. So with our amateur and professional muscle-builders. Often they are sheets of superficial muscle, yet constipated. It is found that developing the biceps

European Systems.



[*Stage Photo Co.*

MUSCLE CULTURE—THE EUROPEAN STYLE

Carnera, the Italian boxer, showing the specialised development which the European "professional muscle-builders" tend to over-do.

Copyright Photo.] [By Effie A. Hornibrook

NEW ZEALAND NATIVE DANCE EXERCISES—I.

A series of photographs showing the muscular movements involved in two native dances. (*Above*) three positions in the Paddle Dance.

does not in itself make the bowels function regularly and frequently. Whenever external activity and internal activity fail to be correlated, we recognise this as a defect, and try to remedy it by adding "deep breathing" to some few abdominal movements. But these are of such limited range that no really efficient working of the internal organs results.

Active athletics usually is limited to early life and the development gained is more or less lopsided, the practice spasmodic, and the ex-athlete often becomes physically unfit in early middle life. Apart from this we have modern ballroom dancing – enjoyable as a recreation and amusement, but the trunk movements have been reduced almost to vanishing point. Physically fit men may be good dancers, but dancing will not make and keep them fit. In boxing two men participate actively, and two thousand or twenty thousand look on, and the same applies to football, cricket and so forth. Lastly, we have naval and military training—systems grounded in tradition and developing along rational lines with tortoise speed, productive of results good, bad, and indifferent. Here the material dealt with is of the best, viz., individuals in early adult life exhibiting no evidence of unsoundness. It is certainly rather a reflection on the whole spirit of such systems that the results do not show a much higher standard of excellence than is discernible.

Thus in spite of our sports, our physical culture, our athletics, field games, dancing, and drill, we have as civilised nations failed to ensure that the majority of adults are physically fit, whereas among the uncivilised nations there are hardly any adults who are physically unfit.

And not only are our bodies defective, but our mental vision is distorted. We look at the perfect forms of manhood among the unspoilt native races, and we seem to think that these men *grew* thus, like the trees of the virgin forest. They did nothing of the kind. The physically perfect man did not grow: *he was made*—made by a system of physical education which, judged by its material results, or by its hygienic effects, is far in advance of anything possessed by civilised nations. For over a century travellers, scientists, missionaries, and Europeans generally have seen these native dance-exercises, and absurdly supposed, for the most part, that they are merely grotesque

antics or unbecoming gestures, more or less meaningless, and fit only for savages. They did not realise that they constituted a rational and valuable system of body-building and personal hygiene, as well as an ordered plan of race-culture.

What are the reasons for the failure of the European system of physical exercise?

(1) A craze for over-specialisation and subdivision. The play element, the athletic element, the exercise element, the dance element, the drill element, all these have been separated and practised as things apart, whereas they are but parts of an indivisible whole in the attainment of perfect bodies in perfect health.

(2) A notion that some parts of the human body are objectionable or indecent, and from these parts attention has been wilfully distracted—that is, from the lower half of the trunk, which contains some of the most important parts of the human body.

In other words, we have failed because of lack of correlation of effort, and because we have left the abdominal and pelvic regions to take care of themselves. The result has been intestinal ill-health, obesity, and other ills.

Consider now the native dance-exercises as illustrated here. To the native mind all parts of the body are important, and no part of the body is indecent. Efficient emptying of the bowels is recognised as the key of health: therefore exercises which hasten along the waste products of the body are right and proper. Virtue and virility are the same thing; therefore exercises for the development of manhood and womanhood are of great personal and social value. This general system of physical education, ensuring complete internal and external efficiency, has been handed down graphically and by word of mouth from time immemorial. But it is open to constant improvement. The native mind is rigid in its acceptance of certain fundamental principles, conservative in cherishing well-tried customs, but elastic in regard to the admission of variations properly presented and suitably tested. Such variations as are discovered by the individual are submitted to the community, then tested thoroughly, and rejected or accepted on their merits. If accepted, the discoverer goes about freely teaching the new movement.

Native Exercises.

Copyright Photos] *[by Ettie A. Hornibrook*

NEW ZEALAND NATIVE DANCE EXERCISES—II.

The Hura (belly) Dance, front view of first movement and front and back views of second movement. These Maori dances develop the abdominal and pelvic muscles and stimulate digestion and evacuation.

Thus it is not by guesswork that the abdominal and pelvic region was made the pivot of native dance-exercises. The native belief is that if the lower half of the trunk is properly exercised and developed, the rest of the muscles can be and are thrown into action simultaneously. Consciously or unconsciously, they know that the only really efficient and scientific system of physical exercise is the one that is directed by what we term "the abdominal brain."

In the nature of things this must be so. By the very structure of the skeleton, it is the soft and boneless abdominal wall that possesses the greatest freedom of movement. The limbs are only appendages; the chest is encaged by the ribs and other bones; the abdominal and pelvic parts of the body, on the other hand, are free-hung and capable of the widest range of rhythmic rotary movement. Such movements stir the abdominal contents into healthy activity, prevent the deposition of surplus fat, and strengthen and develop the whole of the abdominal and pelvic muscles in particular. Compared with these native movements, the best of our European systems of physical culture make provision for a very trifling amount of movement of the viscera—up and down in deep-breathing, or backwards and forwards in certain floor exercises.

Not merely did some native races know what kind of exercises were most beneficial, but highly developed "natives," such as the New Zealand Maori, knew also the best order in which to perform them. Speaking generally, that order is as follows:—

(1) VIBRATION—to loosen up the body.

(2) BREATHING EXERCISES—to ensure clean blood to the muscles.

(3) ABDOMINAL, GLUTEAL, AND PELVIC MOVEMENTS—to stir up the organs and promote evacuation.

(4) VIBRATION—to ensure relaxation and rest.

These exercises were done the first thing in the morning on an empty stomach; sometimes the last thing at night as well. Performed thus, it was found they could be carried on for hours without undue fatigue but rather with physical exhilaration and refreshment, by the young and the old, the weak and the strong—in fact by everybody capable of abdominal movement. In cases of sickness there were special remedial exercises practised by certain native races. The dance-leaders were mature men—that is, men well on middle life, sometimes men over fifty years of age. It is to this system very largely that the native races owe their splendid physique and perfect health. While he was undemoralised by civilisation, the native man's bowels functioned properly, and his abdominal and pelvic muscles never became fatty and wasted. There was no such thing in primitive life as the stagnating bowel and the more or less stationary abdominal wall.

System of Exercise.

Clearly, then, native health and efficiency were not something the natives inherited, but something they acquired: something which they maintained by daily effort. The same results, therefore, can be achieved to-day by all normal civilised men and women, old and young, weak and strong. Of course, Europeans have not the time, and some have not the strength, to do native dances for several hours daily; but in suitable "tabloid" exercise form it is quite possible for us to apply the principles expressed in these dances, and hence to benefit our health and improve our physical efficiency: to become better men and women in every way. This is precisely the system I have devised in my book, *The Culture of the Abdomen*. There a set of eight exercises is described and illustrated. In these exercises effort is localised to the abdominal region—to promote internal abdominal activity—and attention has been directed to correct posture. In tabloid form these eight exercises embody the principles on which the native dances are based, two of the most important of which are shown in the accompanying illustrations.

In addition to set exercises, occasional attention to the musculature of the lower half of the trunk is necessary and desirable during the waking hours. As has already been emphasised, one of the main causes of

constipation and obesity is the lack of internal and external abdominal activity. When the muscles of the lower half of the trunk are seldom or never thrown into independent action, naturally the deposition of fat goes on practically all the time. This lack of movement also is a direct cause of constipation, as the bowels are not subjected to the stimulating effect of the contracting abdominal walls which surround them—*i.e.* they are not kneaded into action, and kneading of the bowels is a powerful stimulant to their action.

The remedy for undue deposition of fat in the abdominal region as well as for lack of intestinal activity, is *constant movement.* By this is meant the retraction and release, and also the rotation, of the abdominal wall periodically during the day. For example, when standing waiting for a bus or train for a few minutes, instead of wasting the time, perhaps fretting and fuming, imperceptibly retract and release the abdominal wall, thus stirring up the contents of the cavity, preventing their stagnation, and preventing also the sagging of the muscles. With a little practice a rotary movement can be done quite inconspicuously. Similarly when sitting in a chair, retract and release the abdominal well backwards and forwards, and rotate it in different directions. If the chair-back supports the buttocks rather than the shoulders, automatically one sits in the correct natural posture—that is to say, with the abdominal wall tucked in—not falling in a heap on the lap.

Once the idea has been grasped—that the way to key up the body and prevent its jutting, sloping, swelling, bulging and sagging into every sort of external and internal disharmony is repeatedly to contract the gluteal muscles (the muscles of the buttocks) when sitting or standing, when lying in bed or in the bath, when strolling in the park, and so forth, then naturally the mind turns interestedly all the time to daily body-cultivation, and the good health most of us have inherited becomes something to enjoy and develop—not something to neglect and destroy.

The two exercises recommended as the most important are the following: *

EXERCISE I.—HAMMOCK SWING.—Place a folded blanket on the floor. Lie flat on the back on the blanket. Bend both knees, soles of feet on the floor; feet about twelve inches apart, and heels close to buttocks; knees a little apart. It is advisable for a stout person and for elderly people to put a thick pillow under the head (*not under shoulders*) to prevent a rush of blood to the head. Place both hands *flat on the floor.* Now raise the hips from floor about two or three inches. The body-weight will then rest on the head, shoulders, and feet. Vigorously swing from side to side, *keeping the shoulders flat on the floor,* so as to tilt each hip upwards alternately.

Repeat twenty times ten each side. Lower hips to floor. Rest for about five seconds. This constitutes one complete cycle.

Raise hips again, and continue six cycles of twenty beats each; that is, 120 swings with six rests.

This exercise from beginning to end will take about one and a half minutes in all. At first it is best to make each of the cycles consist of six beats, and gradually work up to twenty beats to each movement. With practice the beats will naturally be done more rapidly.

Don't hold the breath. Rest between each cycle. See that the abdomen is held loosely.

If the reader forms the idea of swinging in a hammock with somebody checking the movement suddenly, he will have a clear conception of this exercise. It should be noted that the whole abdominal cavity and its contents swing from side to side. The action on the bowels is most effective. The movement can be practised by delicate women and children without any fear of strain, while it can also be performed by athletes with sufficient vigour to make it a thorough and searching exercise.

EXERCISE II.—TENSING AND RETRACTING.—Position as in Exercise I.—flat on the back

* Quoted from *The Culture of the Abdomen,* by F. A. Hornibrook (7th Edition), by courtesy of the publishers, Messrs. Wm. Heinemann (Medical Books), Limited.

on a folded blanket. Now place both hands under the small of back, palms downwards. Raise the head (chin well down), then raise the shoulders and the legs, keeping knees stiff, the feet coming up about twelve to eighteen inches from floor. The body is balanced on buttocks and hands—the hands being placed backwards or forwards so as to regulate balance. Try to bring head and feet as near together as possible (keeping back round, not hollow) without jerking and without bending knees, until complete contraction of abdominal muscles is obtained. Then lower shoulders and feet simultaneously to the floor, keeping knees stiff on the downward movement. When body and feet are resting on the floor retract the abdomen fully, contracting the buttocks.

This exercise is of great importance in developing all the muscles that cover the front of the abdomen. It is a strenuous movement when done completely. At first, therefore, it is advisable to raise only the head and not the shoulders, and keep feet on floor, or raise the feet only a few inches (especially for stout and delicate persons). At the end of a week raise head and feet a little higher, and so on, avoiding strain, until complete contraction is obtained.

It is better to inhale on the upward movement and exhale on the downward movement, then retract abdomen, contracting buttocks. Pause for a second or two. Then inhale and repeat the movement.

Don't hold the breath.—Don't do this exercise as a breathing exercise.

At the end of a few weeks, when feeling stronger, the following movement may be added: raise shoulders and legs as above, pause for a second, then try and raise shoulders and legs still further; lower, and complete the movement. The action of the abdominal wall is something like the opening and shutting of a concertina.

Begin by doing the exercise six times, gradually increasing up to eighteen times.

NOTE.—In cases of hernia (rupture), it is necessary that the truss or support should always be worn when doing this and all other exercises. For elderly and stout persons, the use of a thick pillow under the head is advisable.

THE GAME IN FULL SWING [Topical

An uncertain moment in a hockey match—a strenuous game adopted by healthy modern woman which was impossible for her long-skirted grandmother.

[Topical

OUT OF THE SCRUM

The variety of vigorous movements repeated in a strenuous game such as "rugger" have a stimulating effect upon all the internal organs as well as upon the muscular system as a whole.

GAMES AND HEALTH

By Major H. J. SELBY, M.C., B.Sc., Hon. Editor of "Physical Education," the Official Journal of the British Association for Physical Training.

GAMES result from a natural desire to move the limbs freely with some definite purpose in mind, and the purpose is generally to be found in the instinctive competitive nature of man. The desire to "play" is one of the most obvious instincts of the human race. Place two children in a room and watch their actions; they will probably rush madly and aimlessly about the room from wall to wall until, this exercise tiring, they will look around for some other form of amusement. One will soon discover that he always reaches the wall a fraction of a second after his friend and he will immediately make efforts to correct this indignity. The previous exercise now becomes a competition, and provided the right spirit prevails the primitive game is now evolved. The child, and for that matter, the adult in the normal state, can no more help desiring to play than he can cease from breathing at will, and the game instinct prevails throughout life from the time when the baby waves its limbs and gurgles in its cot, to the age of the graybeard who takes his pleasures in a more leisurely and dignified manner.

Effects of Games.

In the first place, we must assume that every healthy boy and girl wishes to indulge in some vigorous competitive game and that this desire is continued throughout life. Unfortunately, however, the instinct to play is very often curbed at a very early stage either on account of lack of facilities after the child leaves school, or else on account of insufficient training which results in the timid

feeling of the poor performer. Since Nature generally has some reason in implanting an instinct we must examine the exact effect produced by participation in games.

Since a game involves muscular work, it follows that participation must produce a general development of the muscular system; the limbs will be made firmer, more capable of performing their daily task efficiently and able to withstand hard knocks and sudden strains. At the same time, since the various joints will be exercised, they will become more supple and thus the ever present menace of old age will be warded off. More particularly is this true of the spine, which, as is known, consists of a number of bones separated by pieces of gristle or cartilage. If the spine is not bent and twisted in various directions, as the years pass there is a tendency for the gristle to harden, with the result that the spine as a whole becomes immobile and stiff--a sure sign of old age.

Again, vigorous games call for a great effort on the part of the heart and the organs of respiration: the blood is pumped round at a greater rate; breathing becomes deeper and hence waste products are removed more effectively. Nor do the effects finish here; ordinary exercise affects only the external portions of the body to any great extent, and the deeper portions of the body are left untouched; games, however, since they are particularly strenuous, affect the internal organs. An illustration will explain: a man playing rugger runs along the field, stoops, picks up the ball and with a vigorous twist of the body and a quick movement of the arms, propels the ball towards another player on his own side who is better positioned. In stooping to pick up the ball the player is compelled to make a tremendous call upon his abdominal muscles which contract vigorously and, probably, to their utmost power; also in making a twist of the body other abdominal muscles are brought into vigorous play. In contracting, these muscles must produce a vigorous squeezing action upon the internal organs and the sudden squeezing and relaxation has a stimulating effect upon the organs affected. Consider, also, that the two movements mentioned are taking place continuously for nearly two hours and it will be easily seen that the beneficial effects produced must be considerable.

It is sometimes suggested that the effects of games are solely physical. This is a great error, and for two reasons. In the first place, the brain is a physical organ and depends for its maximum efficiency upon the correct functioning of the other organs of the body. Thus, since games improve the quality and supply of the blood to the body it follows, since the brain requires blood, that the brain itself must benefit from the games. Consequently, a person who takes part in games may be expected to think more clearly than one in whose body the blood runs sluggishly. In the second place, the playing of games teaches certain very definite virtues which are of value if we are to live our lives happily in association with our fellow creatures. The expression "to play cricket" has long been one to receive great support as a moral ideal.

"Exercises" and Games.

One further word on the question of effects. Since the war there has been displayed by the public an increasing interest in the subject of health, and the subject of exercise has received considerable prominence. Exercises have been designed to reach every part of the body and the practice of the "daily dozen" is becoming more popular. Such exercises, provided they are based upon scientific principles, are undoubtedly good, but they do not take the place of games in any way. In the first place, an exercise produces a corrective effect: thus, for example, a person exhibiting a tendency to round shoulders may correct this by performing certain exercises which strengthen the muscles of the back; flat feet may be cured by other exercises, and so on. Games undoubtedly will not do any of these things since the body will take the line of least resistance, and it is true that continuous performance in a game may produce a body deformity. The man who plays in the rugby scrum often develops a tendency towards

round shoulders; the tennis player obviously develops one side of the body at the expense of the other; the boxer invariably has a tendency towards a raised left shoulder.

In this respect, therefore, ordinary physical exercise acts as a corrective to the faults made not only in ordinary life but also by participation in games. On the other hand, there are certain aspects in the performance of a game which cannot enter into the performance of an exercise. In the first place, an exercise is an individual matter and is performed for the immediate effects it will produce upon the body. A game is, generally speaking, a "family" affair, and the immediate object of the game is something apart from the individual: a game, in short, is a social matter and the learning of a game encourages the development of social qualities. Again, since a game is a *game*, it tends to make the player forget himself, and thus he is more likely to put more effort into his movements than if he is performing an exercise. Moreover, a game lasts for a considerable time, and to spend the same time upon a group of exercises would become both monotonous and exhausting without producing a corresponding physical benefit. It follows, therefore, that both the exercise and the game have a definite place in any scheme of training, and training cannot be considered complete unless both are included.

Courtesy] [" English Women in Life and Letters," Phillips & Tomkinson (O.U.P.)

"FOR BEAUTY AND HEALTH"

Exercises recommended in early Victorian days for the private tuition of ladies.

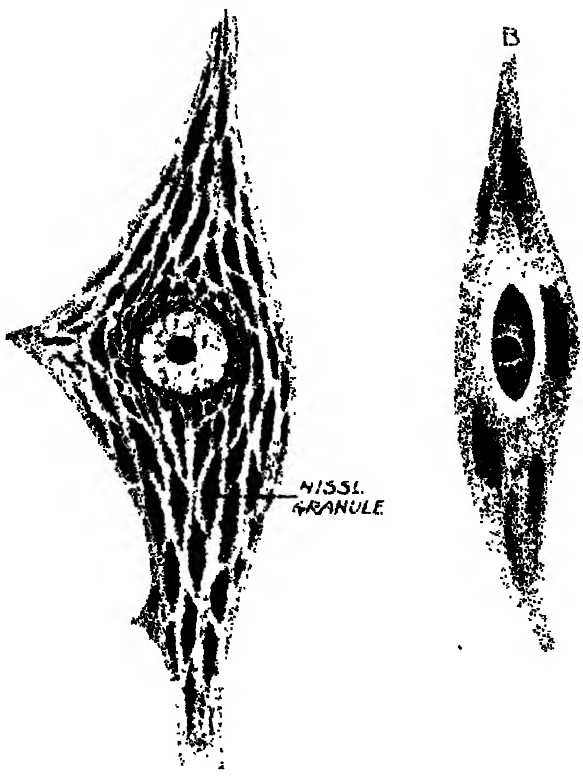
Games to Play.

It is not an easy matter to take up a game after the adult stage has been reached, unless the individual has had considerable experience of playing games in childhood. A person who has never played a serious game in his life will find it extremely difficult to achieve any degree of skill in any game which he takes up, after say, the age of twenty-five. The moral is obvious. Cultivate a love for games at an early age, and, furthermore, make sure that the coming generation has more facilities and greater encouragement than the present.

Provided the game is played in the open air and in suitable surroundings, it matters little what game the individual chooses. All games have much in common, and it remains for each person to choose that which makes the greatest appeal both from a mental and a physical point of view. Soccer, rugger and hockey have found great favour in this country, since they are strenuous and provide a considerable element of risk in their performance. They also bring the players into close contact, and furthermore, they cater for the "herd" instinct since it takes a considerable number of players to make a team. Tennis, badminton, fives, etc., differ from the former games inasmuch as there is no personal contact between the players and mental skill entirely replaces physical force. On the other hand, these latter games are as vigorous as the former and the developmental effects are equally strong. Golf—a game which is rapidly gaining in popularity—falls in a different category. It possesses all the elements of a game but is far less strenuous than any of those previously mentioned, and in addition to this, although the nervous strain produced in an important match may be considerable, it does not maintain the nerves at the highest pitch of excitement over long periods. Since

it is neither physically nor mentally as tiring as football and tennis it would suggest itself as being more suitable for older people and individuals of a nervous temperament. Young people of normal physique would be well advised to adopt another game in addition to golf, or else to leave the game alone till a later stage.

One further word whilst on the subject of particular games. It has been customary to imagine that there are only four or five games – football and hockey for the winter, cricket and tennis for the summer– and golf for the old men! Of late years, however, since the subject has received scientific attention in the schools, several other games have come into prominence—net ball, stool ball, captain ball, rounders –or its more vigorous child —baseball, and rugby touch. These are all good games and appeal to children, and it may be that in the future they will play a greater part in the activities of the adolescent and young adult than hitherto.



THE PHYSICAL EFFECT OF EXERCISE
Muscle-supplying nerve cells (*A*) before, and (*B*) after prolonged muscular activity. The Nissl Granules—the source of potential nerve energy—have disappeared in (*B*).

In a short treatise of this type it is impossible to give individual assistance and advice for all games, but, as stated elsewhere, there are certain basic principles which are common to all, and the reader is advised when thinking of the following points to picture the game with which he is most familiar.

Essentials of a Game.

In the first place, one of the most common faults in a ball game is to remove the eyes from the ball either when striking at it with an instrument or a part of the body or else when catching. With the indifferent player there is a tendency to watch the ball up to a certain point and then to lift the eyes to the point where the ball is intended to land. First point, then, *Keep your eye on the ball.*

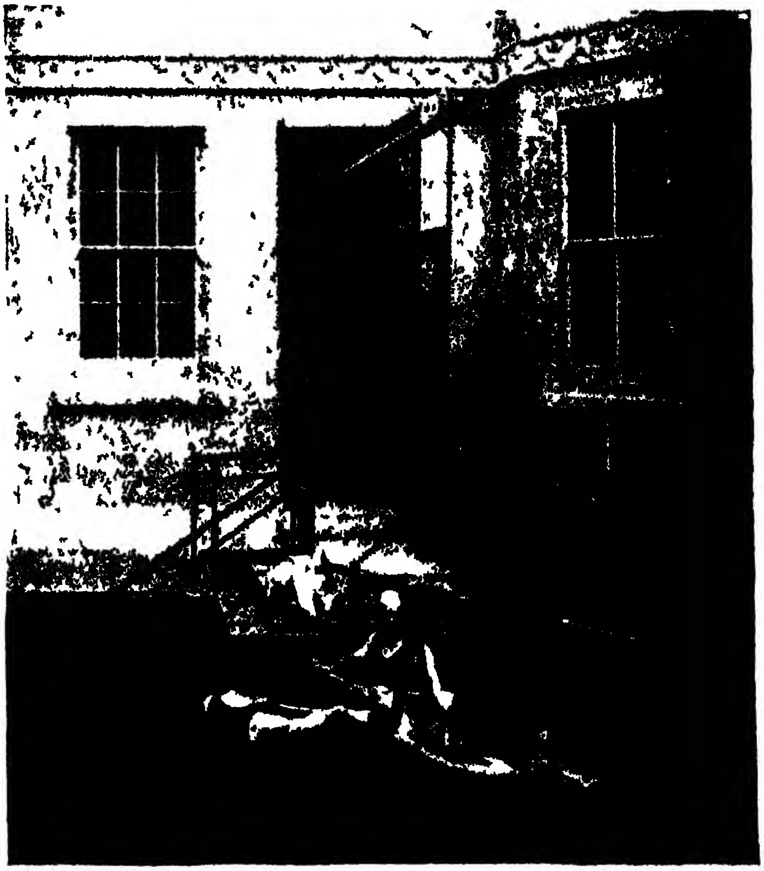
Secondly, make sure that the position of your body is correct both when you receive and when you strike the ball. As a general rule, get your weight over the ball and always control your body so that your balance is correct and so that you may move in the required direction after you have made your stroke, without strain and hesitation. Point two—*Study the poise of your body.*

Thirdly, never expend more energy than is required for the particular action in hand; every ounce of energy you expend unnecessarily means that your reserve strength is being sapped away, and when you require that little extra at some important point in the game it will not be forthcoming. Point three—*Conserve your energy.*

Fourthly, when you are using an implement such as a bat, a hockey stick, etc., make sure that you have a proper grip and that you have full control. When the moment arrives for striking, the success of your hit will depend upon whether you have control and can therefore hit the ball at the right moment and with the exact and correct part of the implement. In passing, this also implies that the player must be able to

judge distance and direction correctly, an achievement which only comes with constant practice.

Lastly we come to the question of tactics. If it is a team game then success will be assured only when each member of the team has complete understanding with the others. If the game is an individual effort then the individual must have complete confidence in himself Whichever form of game, the successful player must be quick to observe and seize chances, and must at the same time be able to obscure his own intentions so that his opponent may be deceived · observe the care with which a break bowler endeavours to hide the type of break he is going to deliver to the opposing batsman



Courtesy]' [The Spa Dire tor Bath

REMEDIAL EXERCISES AT BATH

Re-educative movements in the hot pool at Bath for restoring the function of partially paralysed limbs

If we are to get the best physical benefits out of our games, it should be obvious that undue strain must at all times be avoided. In some respects, unfortunately, the team spirit and the spirit "to do or die" are too strong We have all heard of players turning out for their team when a day in bed would have been much wiser, and of players continuing a game after having received some injury which commonsense suggests requires immediate attention. Laudable though the object prompting these actions may be, it must be remembered that neglect often means pain and suffering and sometimes a total abstinence from games in the future. The player should use his or her commonsense in these matters and remember that although the human body is a wonderful organism, yet it can only be maintained at its high state of efficiency by careful and sympathetic treatment. The same remarks will apply equally to men and to women There are not many games played by men which cannot also be played by women. By this it is not intended to suggest that in the more strenuous competitive games men and women should compete on equal footing and one against the other Many of the arguments brought forward to persuade woman back to the late Victorian days are contradicted in the light of experience. Women and girls may indulge in most games —with the exception of both association and rugby football with excellent results.

Exhaustion and Strain

Undoubtedly it has been the desire to enjoy sporting recreation which has led them to the adoption of their present light, free and hygienic clothing- an event which has reflected itself in the greatly improved health and physique of the modern girl as compared with her sister of a past generation.

THE ART OF MASSAGE

By WINIFREDE BUTLER, S.R.N.

MASSAGE is a highly scientific remedial agent calling for specialised knowledge and much patiently acquired skill. Contrary to general opinion, it is not a modern discovery. In Oriental countries there are records of rubbing as a cure as far back as 3000 B.C., and to this day the Japanese excel in the art. It was not till the beginning of the nineteenth century, however, that massage was established on a scientific basis in Europe.

In both surgical and medical work massage is of great benefit, and to-day it is being increasingly employed in conjunction with remedial exercises and electrical methods of treatment. When prescribed for a serious injury or disease, it should invariably be left to a qualified masseur. There are, however, many minor ailments which can be benefited at home by the amateur, provided he is armed with a fair knowledge of anatomy and of the theory of the various movements.

The object of massage is to manipulate the soft tissues of the body with a view to :—

Objects of Massage.

(1) Stimulating the blood and lymph flow to bring an increased supply to the surface of the body ;

(2) Stimulating the nerve endings ;

(3) Soothing the nerves ;

(4) Improving the functions of the skin to aid the excretion of waste matter through the pores ;

(5) Breaking down adhesions ;

(6) Reducing swelling and thickening of tissues ;

(7) Improving the nutrition of all the parts by an increased blood flow.

The various movements employed in the process consist of :—

(1) Stroking or Effleurage.
(2) Kneading or Pétrissage.
(3) Friction.
(4) Percussion or Tapotement.
(5) Vibration.
(6) Passive and Active Movements.

(1) EFFLEURAGE.—In this movement the pressure should always be applied in the direction of the venous flow, *i.e.*, towards the heart. The cushions of the fingers or the whole palm of the hand is placed a little below the area to be treated and a long upward curved stroke, with slight pressure, is made, the hand gliding back to the starting point without pressure. This is repeated in overlapping curves twenty to thirty times until the whole surrounding area has been covered. In the case of a limb, the joint below and the joint above the part should be included. Throughout the process the operator's hand should not be lifted from the patient's body but should continue in long rhythmical sweeps. Jerky movements are very irritating. The pressure applied should vary according to the result desired ; where the object is to soothe it should be light and the movement slow ; if stimulation is the aim, it should be firm and the strokes fairly swift. Effleurage usually completes a séance after more vigorous movements have been applied. It acts chiefly upon the superficial blood vessels, nerve endings, and sweat glands. In order to reach the deeper underlying tissues one has recourse to pétrissage.

(2) PÉTRISSAGE is a deep movement carried out on the muscles by means of which they are picked up from the bone and rolled, squeezed and kneaded. Where the muscle is a small one, as in the hand, it is picked up between the fingers and thumb and rolled, first by the fingers against the thumb, which is kept rigid, and then by the thumb against rigid fingers. This is done four or five times and then a slight onward movement is made and the process repeated, until the whole muscle has been treated. Where the area is a large one, as on the arm or thigh, the muscle should be thoroughly grasped with the whole of both hands, the fingers should be kept steady whilst the palms and thumbs work against them in a deep upward spiral motion, gradually working up the limb, each movement overlapping the last. The hands then glide down and work slowly upwards again until the whole muscle has been

A LESSON IN MASSAGE [Keystone

Students at the Westminster Hospital School for massage, learning how to manipulate stiff muscles and joints.

thoroughly manipulated. As in effleurage, the direction must always be towards the heart. An even motion is essential as the regular compression and relaxation urges on the blood stream, stimulates the nerves and empties the tissues of surplus lymph which is carried away by the deeper lymphatic vessels.

(3) FRICTION consists of rubbing and kneading the muscles without picking them up from the bone. It is chiefly used around joints and where it is necessary to break down adhesions and to disperse thickened tissues. The cushions of the thumbs are placed on one spot and without moving at all on the surface of the skin they are made to describe small circles with a fair amount of pressure, thus rubbing the underlying tissues over one another. This movement is repeated five or six times and then the thumbs are gently glided on to an adjacent part and the process repeated until the whole surface has been covered. In the case of a joint it should be completely encircled. Where it is found more practicable, the cushions of the fingers or the palms of the hands are used, for instance for the sole of the foot the latter will be found the best medium. Friction should never be used by the novice over a painful or an inflamed area, more especially around joints. It should always be followed up by effleurage to disperse any accumulated fluids.

(4) TAPOTEMENT or percussion requires much practice to be performed effectively. A light hand and a supple wrist are absolutely essential to carry out the movement, which must be light, rapid and resilient. Where the area under treatment is a large one both hands are used to " pound " the muscle. This is done with the " ulnar " or inside edges of the lightly closed fists. Each

hand strikes alternately, giving a slight outward twist from the wrist as it comes in contact with the patient's body. The movement is repeated backwards and forwards and in every direction until the whole surface has been covered. Over small or delicate parts slapping replaces pounding; this is done by rapidly striking the part with the fingers held close together, the motion coming entirely from the wrist. Hacking is another useful stroke. This is done with the open hands held slightly apart, palm to palm, and with the fingers separated and limp. Each hand strikes alternately and in doing so first the edge of the hand and then the tips of the fingers come in contact with the patient's skin producing a sharp stinging sensation which is very stimulating. Hacking is mainly performed over nerve centres.

(5) VIBRATION is applied along the course of nerves. It is a sensation of trembling passed from the operator to the patient via the finger tips or the palmar surface. The finger tips lightly drawn together are placed over a nerve, the operator's hand and wrist are kept quite limp whilst the muscles of his arm and forearm are made to contract, thus producing vibrations. The movement must always be rapid and even and the progress along the nerve almost imperceptible. For the abdomen, back, or similar large surfaces the palm of the hand is applied and vibrated. This movement requires much skill and practice. It is very fatiguing for the operator and not to be recommended to the novice.

(6) PASSIVE AND ACTIVE MOVEMENTS are re-educative and are of great value in the after-treatment of fractures. Passive movements are so called because they are performed entirely by the operator; they are necessarily made at the joints. The left hand steadies one side of a joint whilst the right hand grasps the bone in apposition and goes through the movements of flexion, extension, abduction, adduction and circumduction, two or three times, very gently at first and then more vigorously. For instance, in the hand each phalange is manipulated separately, and when this can be borne without undue discomfort, active movements are begun, that is, the same motions are gone through by the patient entirely unaided. At a later stage resistance is given and offered. For example, the masseur places his palm against that of the patient who is encouraged to flex his wrist, the operator meanwhile holding his own wrist quite rigid. The process is then reversed, the patient offering the resistance whilst the masseur presses. The force used by the latter should, of course, be graduated and increased as the patient progresses. These movements are excellent for restoring strength and flexibility to joints which have been immobilised for a time.

Massage should always be performed in a warm airy room, for deep breathing is an essential accompaniment of the treatment. Lubricants, especially medicated oils, should not be used in the process; the rubbing in of drugs for absorption is known as inunction and belongs to another branch of therapeutics. A light sprinkling of powder on the hands is all that is required to keep them dry and to enable them to glide more smoothly over the skin.

Uses of Massage.

The uses of massage are manifold, a few of the more common ailments with their appropriate treatment are enumerated below:—

LUMBAGO.—The whole base of the back should be deeply kneaded and friction applied over the painful parts, followed up by pounding, hacking and brisk effleurage.

SCIATICA.—Deep kneading of the thigh and buttock, hacking over the course of the nerves, if it can be borne, followed by light effleurage.

RHEUMATIC ARTHRITIS.—Light friction around the joints followed by effleurage. Later passive and active movements.

INSOMNIA.—Light effleurage over the spinal column and forehead.

CONSTIPATION.—Deep kneading along the course of the colon beginning at the right-hand base of the abdomen, working upwards, transversely under the ribs, downwards on the left side, and then inwards

towards the rectum. Vibrations with the palm followed by effleurage.

OBESITY.—Deep kneading and pounding of the tissues alternating with effleurage.

SPRAINS.—The surrounding parts should be treated with brisk effleurage. When pain and swelling have subsided, apply light friction and effleurage to the seat of injury.

VARICOSE VEINS.—Pressure should on no account be applied over the veins; knead and stroke the surrounding tissues, working always in the direction of the heart.

FRACTURES.—When the splint is first taken off, light effleurage. Later pétrissage and friction around the seat of fracture and around the joints, alternating with effleurage. After a few days, passive movements, followed up by active and resistive exercises.

If at any time the patient shows signs of undue pain or fatigue, or his temperature becomes abnormal, treatment should be stopped until a doctor has been consulted.

BATHS IN HEALTH AND DISEASE

By A. CRAWFORD SINCLAIR, M.D., Member of the International Society of Medical Hydrology.

THE failure on the part of the skin to adapt itself to changes in temperature, climatic and otherwise, is responsible for many illnesses; for example, patients of a rheumatic tendency are very susceptible to changes in the weather. On the other hand, if by any means the functional activity of the skin can be so improved that it is able to withstand changes in temperature, etc., there will be considerably less liability to disease.

The Skin.

This is precisely where the value of "balneological" or "hydrological" treatment comes in. Not only is it applied as a curative measure, but by the judicious employment of water at different temperatures in the form of baths and douches, steam and hot air, the adaptive resources of the skin can be stimulated and reinforced so that the sensitiveness of the patient to changes in external conditions is thereby materially lessened.

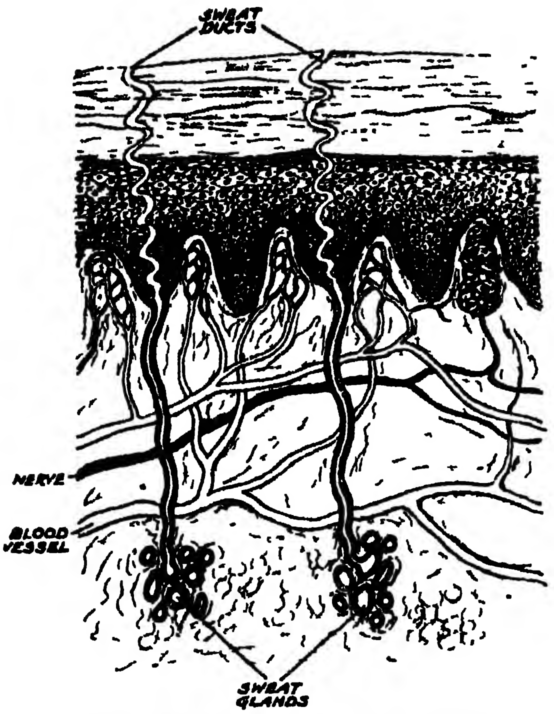
Water.

By reason of its physical properties, water readily gives up heat to bodies cooler than itself, and withdraws heat from those whose temperature is higher. It can absorb more heat than any other substance, and it is always ready to give it up again.

Courtesy] [The Spa Director, Bath

A MINERAL IMMERSION BATH

A mineral water bath with under-current douche.



THE STRUCTURE OF THE SKIN
Showing the sweat glands which help to regulate the temperature of the body, the nerves which make the skin an important sense organ, and the extensive blood vessels which can contain about one third of the body's blood supply.

HEAT AND COLD are relative terms. Objects are recognised as "cold" when they have a temperature lower than the skin.

Kellog classifies temperatures as follows :—

Very cold,	32 to 55°F.	Warm,	92 to 98°F
Cold,	55 „ 65°F.	Hot,	98 „ 104°F.
Cool,	65 „ 80°F.	Very hot,	104° and over.
Tepid,	80 „ 92°F.		

The point of "thermal indifference" of the skin to water is 93 deg. F.

Baths act mainly but not entirely through their temperature effects. Some are, however, employed for their chemical action in certain skin disorders.

IMMERSION BATHS

The plain water immersion baths are :—

(1) THE COLD IMMERSION BATH.—Temperature from 50 to 75 deg. F. By constricting the surface blood vessels it produces pallor and coldness of the skin, and eventually reduces the temperature of the internal organs. It suppresses the activity of the sweat glands.

Plain Water Baths.

If not continued too long it is followed by a *reaction*. The production of a definite reaction should always be the aim and object of the application of cold. For this reason a cold bath should be of very brief duration. If continued too long the reaction may be delayed or may not occur at all.

The skin reddens from the dilatation of the small vessels; there is a pleasant sensation of warmth. The pulse is slowed and the skin perspires.

The conditions favourable to a reaction are a hot bath of some kind immediately preceding the cold application, exercise and friction of the skin, and warm clothing.

There are certain types of individuals who do not respond favourably, viz.: those suffering from thickened and degenerated arteries, very young children, and "rheumatic" subjects. A cold bath acts as a general tonic and stimulant to the functional activity of the body generally. As already indicated, one of its chief uses is to tone up the skin after hot applications.

(2) THE HOT IMMERSION BATH.—Temperature above that of body recognised as "hot," 98 to 104 deg. F. A full bath at anything over 115 deg. F. is unendurable. A hot bath is a powerful vital excitant at first. Its effects depend on the exact temperature employed. Moderate heat relaxes the surface blood vessels. Great heat constricts them at first and in this respect behaves somewhat like an intense cold application. In the case of the hot application the vessels soon relax. The activity of the sweat glands is greatly increased.

The effect of the heat on the surface of the skin is to increase the loss of bodily heat and to lessen the body's general sensibility. Its effect on the general circulation is to deplete one or other of the three great vascular areas, skin, muscles and portal system. It may cause a depletion of the vessels in the brain and thus induce faintness. It lowers arterial pressure and quickens the pulse. It may bring about congestion of the internal organs.

Respiratory movements are facilitated by moist heat, but the amount of "tidal air" is diminished. A prolonged application

diminishes muscular activity. Short applications have a reviving action. The effect on the nervous system of a hot bath is at first exciting and then exhausting.

A prolonged application causes a rise in body temperature owing to diminution of heat elimination by the skin and increased heat production by the internal organs. A short bath will often lower the temperature.

The *reaction* that attends a hot bath is characterised by pallor of the skin, quickened pulse, free respiration, gradual cooling of skin, lowering of internal temperature and lessened perspiration. Nervous irritability is diminished and there is drowsiness and sometimes depression. There is also a certain amount of muscular weakness and indisposition to effort.

The hot bath is mostly employed as an eliminative measure. Followed by a dry pack, it produces profuse sweating. It is a valuable palliative agent in the various forms of chronic rheumatism.* The temperature at the commencement of a hot bath should never be above 98 deg. F. It can be gradually increased up to the required temperature.

Hot baths should be avoided in cases of organic disease of the brain or spinal cord, and also in cardiac weakness and enlargement of the heart. Great caution should be observed with regard to its use in cases of arterio-sclerosis.

(3) THE TEPID BATH.—Temperature 80 to 90 deg. F. Its chief action is to slow the pulse and reduce temperature. It produces little or no reaction. Its main use is in the treatment of fevers.

(4) THE NEUTRAL OR WARM BATH.—Temperature from 92 to 97 deg. F. This is sometimes known as the bath of "thermal indifference." It is a purely sedative measure. It lowers the pulse rate but does not affect respiration. It has also a lowering effect on the surface temperature. It produces no reaction. It is chiefly employed in nervous excitement, neurasthenia and insomnia. It may be prolonged for an hour or more.

* See section on Chronic Rheumatism.

The natural and artificial mineral water immersion baths are:—

(1) SULPHUR BATHS.—Natural sulphur waters (cold) are to be found at Harrogate, Askern, Croft, Strathpeffer, Llandrindod, Llanwrtyd, Lisdoonvarna, and many places on the Continent, where natural hot springs are to be met with.

Artificial sulphur baths are prepared by adding from four to ten ounces of sulphurate of potash to forty gallons of water.

Sulphur baths are generally given at a temperature of from 96 to 100 deg. They have a very beneficial effect on the skin and are distinctly soothing. They have an extensive use in various skin disorders and in many rheumatic conditions.

(2) BRINE OR SALT BATHS.—Natural brine or salt waters are to be found at Droitwich where their strength is roughly three pounds to the gallon. A milder water is in use at Woodhall Spa. There are many similar waters on the Continent.

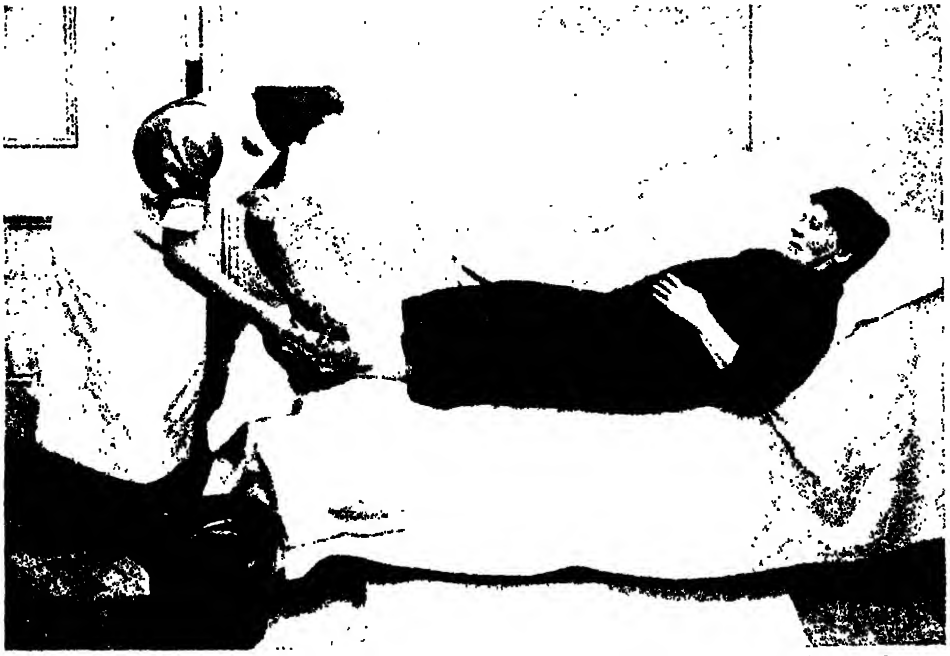
Artificial brine baths are prepared by adding from two to six pounds of common or "Tidman's" sea salt to a bath of forty gallons. To obtain a bath approaching the strength of sea water about five pounds must be used.

A brine bath at a temperature of about 98 deg F. produces free and copious sweating These baths are extensively employed in the treatment of chronic rheumatism.

(3) EFFERVESCING OR CARBONIC ACID BATHS.—The use of the natural effervescing bath is a great feature of many spas abroad.

The bath may be artificially prepared by the addition of a packet of "Nauheim Bath Salts" to a bath of water at a temperature of between 92 and 97 deg. F. These packets are supplied in different strengths. The baths may also be prepared by dissolving fifteen ounces of sodium bicarbonate in forty gallons of water and adding seven and a half ounces of acid sodium sulphate.

The effect of an effervescent bath is mostly due to the bubbles of carbonic acid which settle on the surface of the skin. The heart is slowed and the skin reddens. The bath should be as cool as possible as it contains more gas under such circumstances.



Courtesy] [The Spa Director, Bath

ADMINISTERING A MUD PACK

Special mud is applied hot to thickened or inflamed joints.

obtained from the moor is extensively employed for both general and local baths at Harrogate, Buxton, and Strathpeffer. At Woodhall Spa a mud combined with the local mineral water is used in the form of packs for application to various parts of the body. Muds, deposited on the sea bed, the mouths of rivers and along the banks, or thrown up by volcanic action, are used on the Continent for bathing purposes.

Carbonic acid baths are extensively employed in cases of heart weakness and are usually combined with carefully graduated exercises. They are also valuable in cases of increased blood pressure. From their sedative effect these baths are very useful in states of nervousness, excitability and insomnia.

(4) THE ALKALINE BATH.—The fame of many mineral springs on the Continent depends on the agreeable effects of an alkali on the skin.

An alkaline bath may be artificially prepared by adding ten ounces of carbonate of soda to a bath containing forty gallons of water. The bath should be given at a temperature of from 94 to 97 deg. It is a valuable remedy in many forms of skin disease accompanied by itching. It also relieves the itching of jaundice.

(5) THE ACID BATH.—This is artificially prepared by adding fourteen ounces of dilute nitro-hydrochloric acid to a bath containing from thirty to forty gallons of water at a temperature of between 92 and 97 deg. F. Its action is that of a mild stimulant to the skin and a promoter of perspiration.

(6) THE PEAT OR MUD BATH.—Peat obtained from the moor is extensively employed for both general and local baths at Harrogate, Buxton, and Strathpeffer. At Woodhall Spa a mud combined with the local mineral water is used in the form of packs for application to various parts of the body. Muds, deposited on the sea bed, the mouths of rivers and along the banks, or thrown up by volcanic action, are used on the Continent for bathing purposes.

A peat or mud bath can be given hotter than an ordinary water bath. Its point of "thermal indifference" is about 102, whereas that of water is about 93 deg. F.

Its general action is that of a generalised poultice. The effect on the skin is very marked. Profuse sweating is induced. Mud or peat baths are much used in rheumatic affections, obesity and in long-standing inflammatory conditions.

The application may either be in the form of a general bath in which the patient lies, or the mud or peat may be employed in the shape of a poultice or pack and placed on the area of the body which requires treatment. The latter method gives extremely good results and is more conveniently carried out. For the treatment of muscular and joint rheumatism, as well as in cases of neuritis and neuralgia, packs have proved of great benefit.

(7) THE PARAFFIN WAX BATH.—This is a local application and mostly employed for the hands and feet.

Paraffin wax melts at about a temperature of 122 deg. F. It is melted in a large double

boiler over a gas burner or electric grill. When the required temperature is reached, the hand or foot is plunged into the melted wax and kept there for from ten to twenty minutes. A thin covering of solid wax forms like a glove over the part. It produces intense local sweating and is much used in inflammatory conditions of the smaller joints of the hand and foot.

(8) THE WET PACK.—The patient is wrapped up from head to feet in a wet sheet previously wrung out in water at a temperature of from 60 to 70 deg. F. He is then covered up tightly with two or three blankets and allowed to remain for from a half to one hour or more.

The chief point in applying the pack is to exclude all air from the blanket cover.

The action is at first that of a cold bath. A "reaction" quickly follows, the vessels in the skin dilate and sweating ensues. As the blankets prevent the loss of heat, the patient gets hotter and hotter, and he is usually finally in a bath of perspiration. The wet pack is a sedative measure and is extensively used to promote sleep. It may well take the place of sedative or hypnotic drugs. In cases of fever less water need be contained in the sheet and after about half an hour the blankets should be removed and the whole body sponged over with tepid water.

Courtesy] [The Spa Director, Bath

A NEEDLE DOUCHE

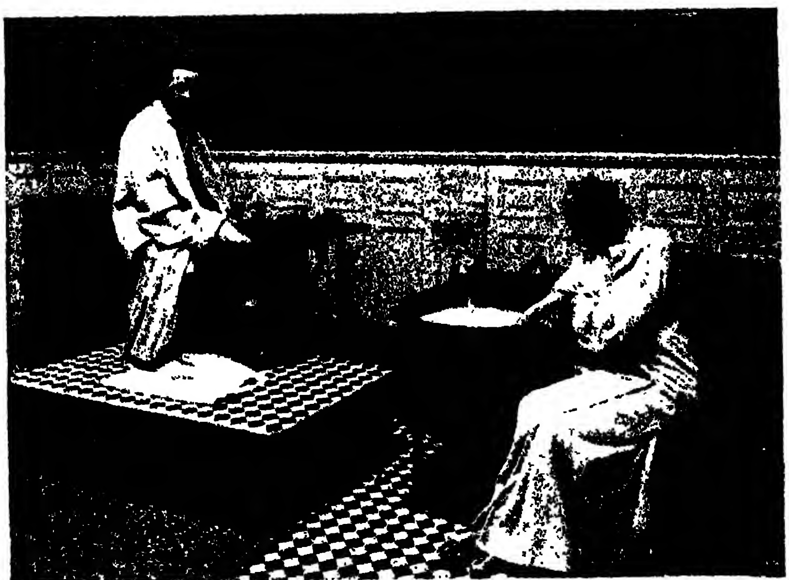
Fine jets of water applied under pressure to the whole surface of the body have a stimulating effect upon the skin.

DOUCHES

Simple Douches.

Kellog defines a douche as a single or multiple column of water at varying temperatures, pressure and mass, directed against some portion of the body.

The pressure varies from ten to sixty pounds, depending on the height of the reservoir or source of supply. The mass varies from a "filiform" douche of extreme fineness to a column of water an inch in diameter. The column may be in the form of a jet, fan, filiform rain or shower, and its direction may be



Courtesy] [Droitwich Baths

LOCAL AERATION BATHS AT DROITWICH

A small type of bath used to treat local conditions.

horizontal, vertical, multiple circular or ascending.

(1) THE COLD DOUCHE.—Temperature 55 to 70 deg. F. It is only given for a few seconds and at a fairly high pressure. It usually follows some bath of a heating nature and the cold douche is employed to bring about a reaction. It combines the effect of sudden cold with that of a mechanical impact. It is therefore much more stimulating than a cold bath.

Its use is that of a general tonic and stimulant and to induce a reaction. It should not be used where there is active inflammation, in arterio-sclerosis, kidney disease and painful affections of the nerves.

(2) THE HOT DOUCHE.—The average temperature of a hot douche is round about 110 to 115 deg. F. It should begin at 100 and gradually work up to the required degree. In using very hot water the stream must be kept in constant motion otherwise there is a risk of scalding the patient.

Its effects are similar to those of a hot bath with the addition of the mechanical factor in the shape of percussion. It is very exciting to begin with, but later it is relaxing and depressing. It is extensively employed for the relief of pain in neuralgic and chronic inflammatory conditions.

The power of relieving pain seems to be one of the specific properties of heat. This is probably brought about by its effect on the circulation. Every one knows the soothing effect of a properly applied linseed poultice in most painful conditions. To obtain the best results the application must be as hot as can be borne.

It is also of value in relieving the intolerable itching in some forms of skin disease.

(3) THE NEUTRAL DOUCHE.—This is given at a temperature of between 92 and 97 deg. F. It acts as a general sedative and has a greater influence on the blood vessels of the skin than a bath of the same temperature. It produces no reaction and has its chief uses in insomnia and nervous excitement.

(4) THE SCOTCH OR ALTERNATING DOUCHE. —This is carried out by the use of two hose pipes, one delivering very cold water and the other very hot. The cold application lasts a few seconds and the hot a few minutes. A rain or shower bath should precede the application in order thoroughly to warm the skin.

The hot application dilates the blood vessels of the skin while the cold contracts them. The cold slows the heart.

The alternate contraction and dilatation of the superficial blood vessels assists in the removal of old inflammatory deposits. It is extensively employed in cases needing general tonic treatment and also in the later stages of muscular rheumatism, and sciatica. It is a valuable application in sprains of joints, especially in the later stages, where there is thickening around the tendon sheaths.

(5) THE RAIN OR SHOWER BATH.—The cold shower bath is generally employed after a hot bath to tone up the skin and induce a reaction.

A hot shower bath is used as a prelude to massage in order to warm up the skin and make it more supple.

Its general applications are very much those of the cold or warm douche to which reference has already been made. The chief difference lies in the direction of the stream which in this case descends from above.

(6) THE NEEDLE BATH.—This is a circular douche with numerous streams of fine jets directed on the surface of the body. Its effects are very much those of the douches described above, with the addition of the stimulation of the skin by means of the fine streams of water under pressure. It is largely used in combination with other baths for its tonic effects.

8. AIX MASSAGE DOUCHE.—After a preliminary rain or shower bath at a temperature of about 98 deg. F., the patient is seated in a chair and the whole body and limbs massaged under a stream of water at a temperature of about 98 deg. F. Usually two attendants are employed, one to manipulate the hose-pipe and the other to perform the massage.

Manipulation Douches.

After the whole body has been systematically treated, a strong douche is applied to the front and back of the patient beginning

with a temperature of 96 deg. and finishing at 60 deg. F.

9. VICHY MASSAGE DOUCHE.—After a preliminary shower bath at 98 deg. F. for a few minutes, the patient lies on his back on an air cushion placed on a table. Instead of a hose pipe as in the Aix system, the water, at a temperature of 98 deg., is conveyed through three or four rose jets suspended above the table. The water is thus broken up into a number of extremely small fine streams very similar to those of a needle bath. Under these fine sprays the patient is thoroughly massaged.

The main difference between the two systems is that in the Aix system, the patient is sitting up and the water directed in a single column, while in the Vichy bath the patient is lying down and the water is divided up into exceedingly fine jets.

The effects of a massage douche are practically those of a neutral douche with massage superadded. It is a distinctly sedative measure. At a higher temperature it is stimulating and eventually exhausting. The massage is not so tiring to the patient as a dry manipulation. It is one of the most valuable of balneological treatments and has a most extensive use in cases of obesity, chronic rheumatism, and painful conditions of the fibrous tissues immediately under the skin. It is most valuable in the late stages of sciatica as a means of restoring the lost tone of the muscles.

A massage douche in one form or another is obtainable at all our health resorts.

HOT AIR BATHS

THE TURKISH BATH.—The bather proceeds straight to the hottest room and remains there for a few minutes until a free flow of perspiration is induced. From a quarter of an hour to twenty minutes should then be spent in the second room and about ten to fifteen minutes in the coolest room previous to the process of "shampooing." The bath should terminate with a tepid plunge followed by a cold douche.

The air in a bath of this kind is essentially dry and evaporation of sweat from the surface of the body is facilitated. The bodily temperature is therefore not increased. The circulation in the skin is stimulated and the deeper organs correspondingly relieved. The profuse sweating rids the body of impurities.

Turkish baths are largely employed in cases of obesity, gouty conditions, and chronic rheumatic affections. They should not be indulged in by patients suffering from weakness of the heart, arterio-sclerosis (thickened blood vessels), and Graves's disease.

THE VAPOUR OR RUSSIAN BATH.—This differs from a Turkish bath in that the air in the latter, although heated, is dry, and the influence of moisture negligible. In a Russian bath the air is charged with wet steam which has a distinct "thermal" effect on the skin according to its temperature.

The vapour bath has been in use from time immemorial. The most ancient method of preparing it was by placing a tub of water in a small building and throwing hot glowing stones into it.

The vapour bath checks evaporation from the surface of the body in consequence of which heat is retained and the temperature is raised. In this respect it differs from the Turkish bath where evaporation is encouraged and the temperature maintained at an even degree. The vapour bath is a very powerful agent for ridding the body of impurities.

After a varying period of from a quarter to half an hour in the "vapour room" a cold needle or shower bath is administered. The application of cold is most important. In Russia and Finland it is customary to roll oneself in the snow after being in the "sweating" room. Among these people an hour in the sweating chamber followed by an intense application of cold is regarded as a sure protection against disease.

A more extended use of baths of this description in this country would undoubtedly do much to "tone up" the skin of susceptible individuals and thereby raise their resistance against the onset of disease.

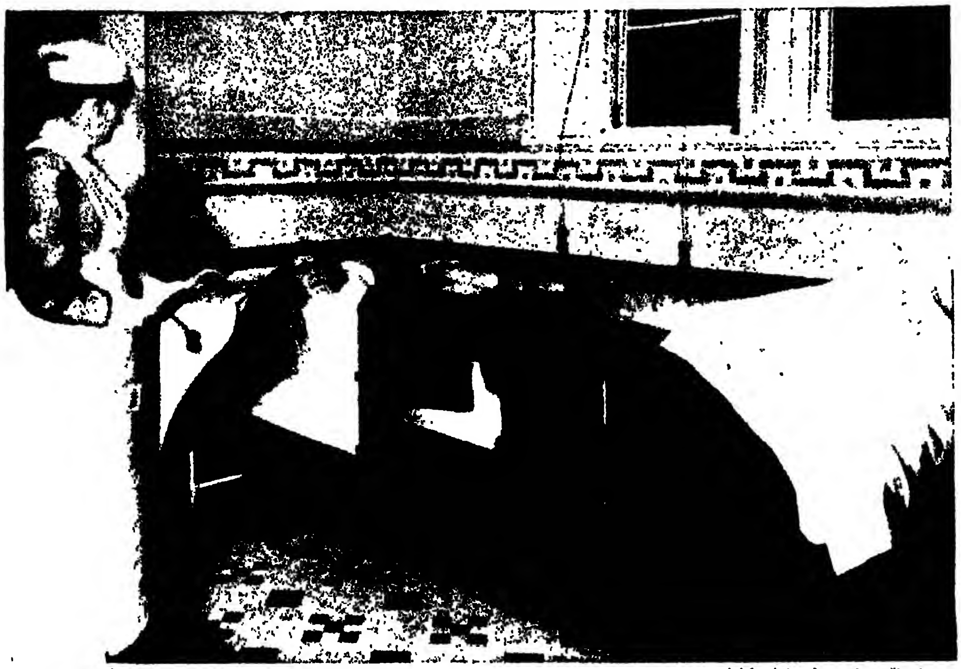
THE "CABINET" VAPOUR BATH.—This

is administered in a cabinet which allows the head of the patient to be outside. For this reason it is less exhausting. The steam is usually conveyed either by means of a pipe from outside or by some water heating contrivance inside the cabinet. Its action is very much that of the Russian bath referred to above. It should always be followed by a cold application in some form or another, usually a douche or needle bath. It is used extensively in cases of chronic rheumatism, neuritis and neuralgia. It is not for the old and feeble or in cases of heart disease.

LOCAL VAPOUR BATHS.—These are generally known as "Berthollet" baths and consist essentially of metal chambers into which the limbs can be introduced. Steam is conveyed from outside and the whole limb exposed to its action.

They are most valuable in the treatment of various joint and muscular affections. These baths are almost always used as a preliminary to massage of the part. The action of the vapour is to make the muscles more supple and the succeeding manipulations more effective.

ELECTRIC RADIANT HEAT BATHS.—The



Courtesy] [The Spa Director, Bath

ELECTRIC RADIANT HEAT TREATMENT

Used in gout, rheumatism and other painful conditions to improve the circulation and eliminate impurities by inducing copious perspiration.

thermal effects of practically all the measures that have been dealt with above are produced by direct contact with the skin by the medium in which it is enveloped. The water, vapour, air, peat or brine, or whatever is employed communicates its heat by contiguity. Radiant heat is not "conductive," but "convective." The rays of the sun, the best example of convective heat, do not normally heat the air through which they pass. They only warm bodies through which they do not pass. If the atmosphere is full of moisture, particles of water will be warmed, hence the oppression of a warm damp air.

A radiant heat bath is given by means of a cabinet containing some forty-eight or more incandescent lamps arranged in vertical rows round the interior. The head of the patient is outside. Cabinets are also so constructed that the patient may lie down.

The beneficial effects of heat applied to the surface without the disadvantages of "conductive" heat are thus obtained.

The action of this bath is to induce free perspiration and dilatation of the blood vessels of the skin, whereby the circulation is favourably influenced and the elimination of impurities from the body is obtained.

It is used in gout, chronic rheumatism, sciatica, and many forms of neuralgia.

LOCAL RADIANT HEAT BATHS.—Appliances for local use for an arm, leg, shoulder, etc., with two or three heating units, are available. They are mostly employed in cases where a full bath is not required.

Electric Water Baths.—The patient lies in a bath of water at a comfortable temperature. Two metal plates connected with a source of electric supply are placed in the bath, one at the head and the other at the feet. Either the continuous (Galvanic) or interrupted (Faradic or sinusoidal) currents may be used.

The water in the bath acts as an "electrode," *i.e.* a conductor by means of which a current of electricity is supplied to the body. A bath of this description is "bipolar," *i.e.* both poles connected by metal plates with the water. Only a portion of the current passes through the patient, the rest is wasted in passing through the water.

Local Electric Water Bath (Schnee's four-cell electric bath).—The patient sits in a chair so arranged that he can place both arms in arm baths one each side and both feet in foot baths. Four small tubs in all. Each of these tubs or "cells" is connected with a source of electric supply and the current can be made to traverse the limbs in any required direction. One arm and one leg can be treated or all four limbs. This is a "monopolar" bath in that only one metal plate is placed in each bath. The patient therefore gets all the current.

By means of a switch arrangement the baths can be made "positive" or "negative" at will, and either the Galvanic or Faradic current can be delivered to the patient.

Both the electric water bath and the Schnee four-cell bath are extensively used in cases of paralysis from toxic causes or nerve injuries, rheumatic and gouty conditions, and certain diseases of the blood vessels.

BRITISH SPAS

By A. BASSETT-JONES, M.B., M.R.C.S., L.R.C.P., (Llandrindod Wells), Formerly Senior Assessor to the Ministry of Pensions, Wales.

MEDICINAL springs, like coal, issue from the bowels of the earth. Both are natural products; both are national assets; and just as coal is essential to national prosperity, so also do we begin to realise that our British spas are destined to play an ever-increasing rôle in the promotion and establishment of national health

A FASHIONABLE SPA IN THE EIGHTEENTH CENTURY
Famous for its mineral springs since the time of the Romans, Bath was especially gay and fashionable in the time of Queen Anne and throughout the eighteenth century.

and efficiency. This the more certainly in that to-day we recognise that the true ideal of medicine is the *care of health*, not the cure of disease.

Nevertheless, so deeply rooted is the idea that spas are merely places for "cures," that we almost wholly overlook the fact that the ideal function of a spa is preventive rather than curative. Obsessed by this tradition, we are but too apt to tarry until disease is established, and then, and not till then, do we repair to a spa, and the expected "cure" not materialising, vent our spleen on the "waters." The fault lies in ourselves. To avoid disappointment and no less to give their waters a fair chance, spas should be resorted to "in the day of small things" when disease merely "threatens," and is not as yet established. For only when this principle has been thoroughly grasped and acted upon will our spas attain to the zenith of their capacities for raising the standard of national well-being.

As a recent Congress on Rheumatism (held at Bath) clearly showed, the sphere of usefulness of spa treatment is steadily enlarging, this especially in the domain of prevention. Thus children are rarely sent to spas, but it is now suggested that those born of "rheumatic" parents should undergo courses of treatment to prevent the initial manifestations of acute rheumatism. Hydrotherapy tones up their defective skin action and so renders them less susceptible to weather changes. The same is still more strenuously advocated in regard to muscular and arthritic forms of chronic rheumatism, or fibrositis. Their victims must—if the best results are to be attained—resort to spas in the initial or early stages of these affections. Here in a nutshell we have the reason why a "rheumatic clinic" is shortly to be opened in London for the benefit of insured workers suffering from these disorders.

As to the principles of spa treatment, we have to recollect that the majority of those

Object of Spa Treatment.

who resort to spas are the victims of chronic toxæmia, either of extrinsic (septic teeth, tonsils, etc.), or of intrinsic source (resulting from failure of the subject to get rid of the waste products of metabolism). Now, given that septic teeth or tonsils have been treated or removed, these persons are eminently suitable for spa treatment, the objects of which are (1) to correct or relieve those functional disorders—gastro-intestinal or other—which so often determine outbreaks of rheumatism, gout, etc.; (2) to promote the speedy elimination of toxic products *via* the bowels, kidneys, and skin; (3) to restore the organism so far as possible to a state of health or functional efficiency and therewith to adopt such prophylactic measures as shall diminish the liability to recurrence of the disorder.

The success of spa treatment will naturally depend on the care and discrimination exercised in selecting a spa. To this end, regard must be had not only to the disease but to the individual himself. Happily for this purpose, the British Isles are well dowered with waters of divers kinds, and being located in different areas, differences of climate intervene, which enable us more efficiently to meet the varying requirements and idiosyncrasies of individual subjects. Thus the climate in some is *sedative*, of which Bath, Leamington, and Cheltenham are examples, and such is congenial to elderly persons or those of highly strung temperament. In others the climate is *tonic* or bracing, *e.g.* Buxton and Harrogate, and well adapted for those of plethoric habit in whom metabolism is sluggish. For under its stimulating influence oxidation processes are quickened and elimination promoted. Lastly we have a *tonic sedative* group, viz., the spas of Central Wales (Llandrindod, etc.), Strathpeffer and Woodhall Spa, which are highly suitable for certain types of neurasthenia and persons whose convalescence from acute illnesses, influenza, etc., is tardy or imperfect.

As to the mode of action of the waters at our spas, these vary widely, but since, broadly speaking, the salient purpose of spa treatment is *elimination*, it may be noted that the waters of Harrogate and Cheltenham achieve it principally by the bowel, and hence are eminently suitable for gross feeders with hepatic congestion. Those of

Bath, Buxton, and Strathpeffer act mainly through the kidneys, while those of Llandrindod and Leamington do so *via* both the bowel and kidneys.

Again, though our spa waters differ widely in chemical content, they possess in common —though in varying degree—the added quality of radio-activity. But if in some, *e.g.* the thermal or subthermal (Bath and Buxton), their therapeutic efficacy is referable more to their radio-activity than to their mineral content, in others their relative deficiency in radio-activity is compensated for by their mineral constituents, present in sufficient quantity to exert a specific action, aperient, tonic, and so forth, as in the waters of Harrogate, Llandrindod, Cheltenham, etc. To-day we realise that minerals, such as iodine and sulphur are, like the more vaunted "vitamins," essential to the nutrition of cell protoplasm. Thus iodine is an essential ingredient of the thyroid secretion, and thyroid deficiency or instability being common in rheumatic and gouty subjects, we see how iodine-containing waters such as those of Woodhall Spa prove beneficial in such disorders. Sulphur, again, is normally present in the skin, also in the joint cartilages, muscles, and mucous membranes, hence possibly the well-proved efficacy of sulphur waters at Harrogate, Llandrindod, etc., in affections of the skin, joints, and respiratory system.

In conclusion, it must be noted that, apart from the chronic arthritic diseases due to rheumatism, gout, and other causes, there are many disorders incidental to middle life, *e.g.* high blood pressure, obesity, glycosuria, and chronic catarrhal dyspepsia which are eminently adapted for spa treatment—when the spa has been wisely selected. As for the view, all too prevalent, that—other things being equal—the drinking of a "bottled" mineral water at home is equally beneficial, it may be shrewdly said that the "other things" never are "equal." What of the daily worries left behind, the change of air and scene, the modifications of diet, the leisure for outdoor exercise, as well as the baths, douches, massage, and other accessories of a well-ordered course of spa treatment! In short, it is in the judicious combination of all these factors that the real value of spa treatment lies.

Courtesy] [*The Spa Manager, Buxton*

ST. ANDREW'S WELL, BUXTON

Drawing up the waters for drinking at the well-known Derbyshire resort.

Having brifly outlined the main principles underlying spa treatment it now remains for us to describe some of the more characteristic features of the chief British spas.

BATH

Bath, situated in an open valley practically surrounded by hills, which rise to a height varying from 400 to over 600 feet, is specially protected on the north and east, the predominating winds (45 per cent.) being from the south-west. There are TWO CLIMATES, each adapted to a special type of case. That on the lower level is mild and equable, though relaxing at certain seasons and in some aspects, yet it serves to augment the effect of the treatment which can be given

at all seasons of the year. Spring and autumn are, however, the favourite seasons for a cure. Certain of the outlying parts, such as Lansdowne and Coombe Down, are bracing and breezy. It is one of the warmest places in Great Britain, and by reason of this is essentially a winter spa, being exceptional among European resorts in this respect.

The WATERS are the only hot mineral springs in Great Britain. The springs are three in number and their temperature ranges from 104°F. to 120°F. According to the *Lancet* analysis they contain in a thousand parts: 1.4 calcium sulphate, .3 sodium sulphate, .2 each of magnesium chloride and carbonate of iron, .1 of calcium carbonate, besides lesser quantities of lithium, strontium, and bromine. In respect of radio-activity these waters were shown by the researches of the late Sir W. Ramsay to be the most potent in Great Britain. Their efficacy lies in the high temperature at the source, the presence of the astringent and sedative lime salts, and the contained gases (especially the radium emanation or radon).

The BATHING ESTABLISHMENTS comprise public swimming baths; deep private baths, large enough for the patient to move about, and also fitted with a chair and tackle to permit of helpless patients being lowered into the water; reclining baths with undercurrent douche; Aix and Vichy massage; Scotch douche. In addition there is apparatus for the atomisation of the mineral water besides the different varieties of electrical treatment. Under expert instructions their use should prove beneficial in all forms of fibrositis, osteo-arthritis, gout, sciatica, residual pains and stiffness following acute rheumatism and the results of injuries. They have proved of service also in some forms of nerve trouble, such as the multiple neuritis of lead poisoning, chorea, and some forms of skin disease, such as eczema, psoriasis, and acne.

The waters are of benefit in gouty and fermentative dyspepsias and mucous colitis, when associated with dietetic regulations. In the pulverised form they have proved successful in respiratory affections, more especially those dependent on a gouty constitution.

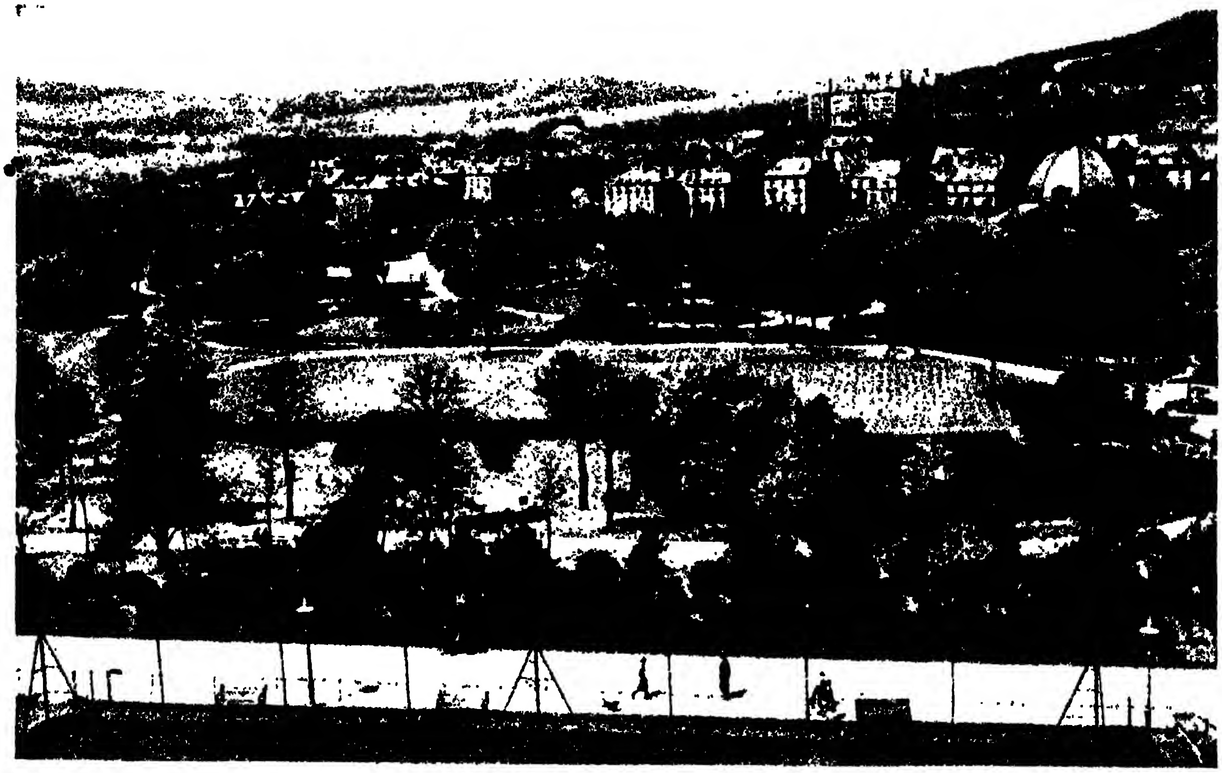
BUXTON

Buxton lies in the middle of the Peak District and is protected from easterly and northerly winds by the surrounding hills, which range from 1500 to 1800 feet above sea-level. It is one of the most bracing health resorts in Great Britain, the air being particularly keen and invigorating.

The WATERS are of two kinds: (1) subthermal, issuing at 82°F., more weakly mineralised than those of Bath, which contain in a thousand parts .2 of calcium carbonate, .1 of carbonate of magnesium, and .04 of sodium chloride. The temperature does not vary, and the most remarkable feature is the large quantity of dissolved nitrogen, as much as 500 cubic inches to the gallon at the source, while in addition it contains a small quantity of carbonic acid gas. There are also present traces of manganese, barium, and iron, besides other metals. It is highly radio-active. (2) A non-gaseous chalybeate spring containing half a grain of carbonate of iron and rather more than a grain of sulphate of lime to a pint. Both are employed internally.

The BATHS are divided into two classes: (1) the *natural* at 82°F. as it emerges from the source, and (2) the *hot* baths in which the water is warmed to the desired temperature by artificial means. Special features are the moor or peat baths made from peat collected in the district, and a special form of massage douche in which the patient lies in a shallow trough filled with thermal water. By means of the latter, manipulations of the joints become easier and less painful.

In regard to indications for treatment, the CLIMATE and waters are beneficial in chronic tuberculous and scrofulous conditions as well as anaemia and neurasthenia. The waters have proved of service in various forms of gout and gravel. The combined use of waters and various forms of baths is valuable in the different types of fibrositis, early osteo-arthritis, high blood pressure, residual pains and stiffness after acute or subacute rheumatism and injuries.



Courtesy] [*The Spa Manager, Buxton*

Courtesy] [*Harrogate Corporation*

TWO FAMOUS ENGLISH SPAS

Above—Buxton, a bracing resort for treating chronic joint affections. *Below*—Harrogate, a spa with sulphur waters valuable in gout, rheumatism, intestinal disorders and many other conditions.

HARROGATE

Harrogate lies on an elevated moorland plateau in Yorkshire, midway between the Irish Channel and the North Sea. While there are no abrupt elevations in close proximity, the tableland is protected on the west side by the Pennine Range rising to 2400 feet and forming a natural barrier to the rain-laden winds of the west. By reason of its elevation and northern latitude the climate is tonic and bracing.

Within the compass of a few acres, there are eighty-seven springs, whose constituents vary in strength and composition. Sixteen or seventeen of them are used internally, the remainder being devoted to external employment. Considered as a whole, they are characterised by (1) a saline component of varying quantity more or less common to all; (2) in addition the existence of either sulphur or iron. Thus the WATERS are practically divisible into two groups—saline-sulphur and saline-chalybeate, and these are again subdivided into strong, medium or mild, according to the amount of total solids present in each. Of the former the widest known is the Old, or Strong Sulphur, containing in a thousand parts 13.3 chloride of sodium, 0.15 sulphide of sodium, 0.1 chloride of barium, and 37 volumes of sulphuretted hydrogen, as well as magnesium, calcium, potassium, and other metals—the total solids amounting to just over two drachms to the pint. The saline chalybeate waters contain relatively large amounts of iron salts. Thus the so-called "Kissingen" well contains in a thousand parts .14 of carbonate of iron, and the chloride of iron spring .19 of chloride of iron and .16 of iron carbonate, besides .07 of barium chloride. The "alum well," though not used internally, is employed in the form of a douche or spray (diluted) for pharyngeal and laryngeal affections. This latter contains approximately about 1 per thousand parts each of ferrous and ferric sulphates, sulphates of aluminium, calcium, and magnesium.

The forms of treatment obtainable in the three BATHING ESTABLISHMENTS comprise the following: sulphur (saline and alkaline), carbonic acid, brine, and peat or moor baths; various forms of douches, combined with massage; hot air and vapour baths and the different electrical treatments.

The CLIMATE, apart from baths and waters, is likely to prove beneficial in the following: tardy or imperfect convalescence after medical illnesses or surgical operations; states of exhaustion in the overworked town-dweller; tuberculous disease of bone or glands; rickets in children; bronchial affections (in summer), catarrhal relaxed conditions of nose and throat; anæmia; neurasthenia (when attended by disability and loss of flesh). Cases of the last type, when associated with sleeplessness and excitability, do not derive much benefit.

The saline sulphur waters are recommended for gouty conditions, chronic muscular rheumatism, sciatica, high blood pressure, glycosuria, obesity, gastric and intestinal affections, derangements of the liver and bile ducts.

The saline chalybeate waters have proved useful in anæmia, imperfect convalescence, sluggish liver, Bright's disease, cachectic conditions following malaria and other tropical diseases, and some forms of neurasthenia.

LLANDRINDOD WELLS

Llandrindod Wells is situated in a sparsely populated and purely agricultural county, Radnorshire. Built on a broad tableland or terrace some 700 feet above sea-level, with an undulating surface about five miles long and somewhat less in width, the town is protected on the east by a range of hills some miles distant known as Radnor Forest. The town as a whole faces south-west, whence comes the prevailing wind direct from the Atlantic and free from contamination by the smoke of manufacturing towns. The open situation on a plateau and the local configuration with the absence of abrupt elevations and dense woods in close proximity ensure free movement of air with, as its corollary, absence of atmospheric stagnation. In addition, owing to the distance of manufacturing centres or large towns with their

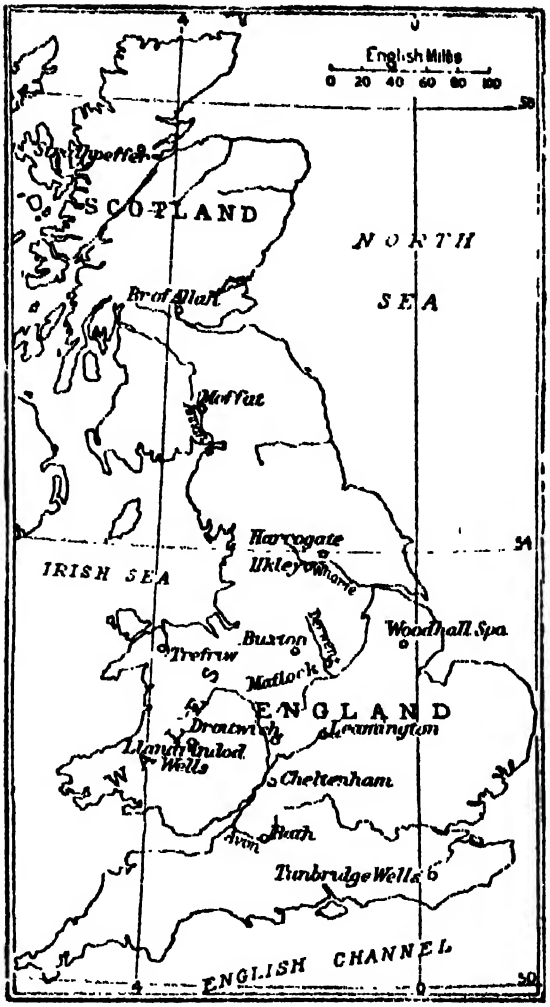
sources of contamination, the air has the peculiar quality of "freshness" so welcome to the jaded person. The CLIMATE is bracing and pleasant, possessing the tonic properties of the mountain air with the added sedative qualities of the sea breezes from the west.

The SPRINGS, analyses of eleven of which have been published, are arranged in distinct groups to the south-east, south-west, and centre of the town, while just outside the southern boundary there is a fourth group. They may be divided into saline, sulphur, and chalybeate. The saline are of varying composition, and have as their chief ingredient sodium chloride, which ranges from 1.8 to 6.2 in a thousand parts, chloride of calcium 0.4 to 1.3, chloride of magnesium .04 to .7.

The sulphur waters contain sulphuretted hydrogen varying from 2 to 2.6 cubic inches per gallon, while the one in Rock Spa known as Radium Sulphur, in addition to possessing an appreciable amount of radio-activity, is stated to have 14 cubic inches per gallon. The chalybeate waters, of which there are two springs, contain from 1.26 to 1.6 grains of carbonate of iron per gallon, while each in addition contains an appreciable amount of calcium salts.

The three BATHING ESTABLISHMENTS afford facilities for the following: sulphur immersion, needle, and douche baths; Aix and Vichy massage douches; colon-irrigation as well as the various forms of electrical treatment.

The CLIMATE and WATERS are especially suitable in the following: those requiring change and rest, such as persons suffering from overwork, either bodily or mental; convalescence after surgical operations or after a severe illness; atonic forms of dyspepsia following errors of food and drink; chronic gastric and duodenal catarrh; derangements of the liver, jaundice dependent on catarrh of the bile ducts; catarrh of the colon; constipation; chronic catarrhal conditions of the nose, throat, and respiratory tract; auto-intoxications and disorders of nutrition, such as gout, fibrositis, rheumatism, sciatica, glycosuria, high blood pressure



THE CHIEF BRITISH SPAS

and obesity; anæmia and neurasthenia associated with debility and loss of flesh; skin diseases, such as eczema, psoriasis, and acne.

STRATHPEFFER

Strathpeffer, situated in the south-east of Ross-shire, is the most widely known of the Scottish and the most northerly of the British spas. Its position in a broad valley, which opens on the east to Cromarty Firth, ensures a mild equable climate, though at times relaxing.

Though the season is from May to October the spa is open all the year.

The WATERS are of two kinds: sulphurous and chalybeate—and all are cold. In the case of the former there are four different wells (1) The cold; (2) the upper; (3) the

LLANDRINDOD WELLS
Intestinal disorders and chronic skin diseases are treated by baths and drinking waters at this Welsh spa, which is also beneficial to convalescent and "run-down" conditions.

strong; and (4) Cromartia, differing as to the amount of sulphuretted hydrogen they contain. The latter is said to contain on an average 23 cubic inches of sulphuretted hydrogen gas to the gallon and is one of the strongest sulphuretted waters in Europe, with a comparatively small saline content, principally sulphates with magnesium, calcium, and sodium. The sulphur water of Harrogate contains relatively much more saline content, notably magnesium chloride, to which it owes its purging qualities.

The Strathpeffer waters, despite the presence of magnesium salts, are not purging, but have a mild aperient action and by reason of their calcium content are diuretic.

The chalybeate "Saint's Well" contains nearly five grains of carbonate of iron to the gallon, or, in a thousand parts, .035 with phosphates and carbonic acid gas.

In addition to sulphur immersion baths various kinds of baths, such as peat and effervescing, are employed. Peat, now so much in use at Harrogate, was first employed at Strathpeffer. Aix and Vichy massage douches as well as the different forms of electrical treatment are obtainable.

The treatment available proves helpful in cases of rheumatism, gout, rheumatoid arthritis, and muscular rheumatism, which usually derive much benefit from the employment of sulphur waters both internally and externally. Lumbago, sciatica and other forms of neuritis are also benefited. The waters are also recommended in mucous colitis, liver disorders and dyspepsia associated with congestion of the liver; chronic cutaneous disorders, such as eczema and psoriasis of a gouty origin. The chalybeate waters are suitable in anæmia, chlorosis, and neurasthenia, while the climate suits elderly people who need rest and change as well as those persons suffering from brain fatigue.

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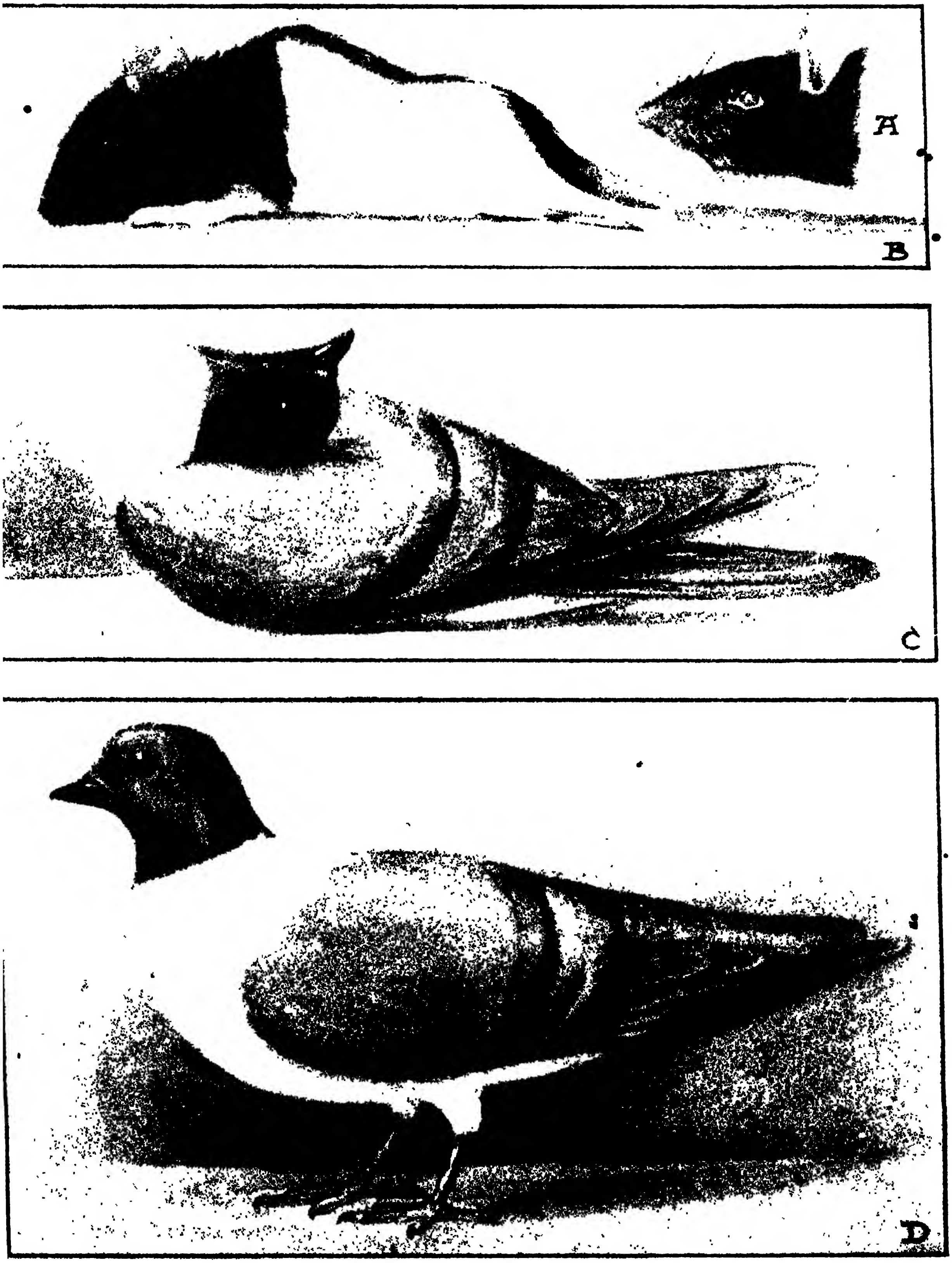


THE EFFECTS OF VITAMIN DEFICIENCY

(A) A rat suffering from Xerophthalmia, an eye disease caused by lack of Vitamin A in its diet. (B) Rat showing characteristic signs of lack of Vitamin B, with legs outstretched and helpless. (C) Polyneuritis in a pigeon due to deficiency of Vitamin B. (D) The pigeon completely cured by addition of food containing the vitamin to its diet.

XX

DIET AND HEALTH

NUTRITION, THE BASIS OF HEALTH

INTRODUCTION

By Professor E. V. McCOLLUM, D.Sc., Professor of Dietetics, Johns Hopkins University, Baltimore.

AMONG the many new developments resulting from scientific research which have significance for the betterment of public health, none is more remarkable than the discoveries in the field of nutrition during the last fifteen years. With every advance in our knowledge of the nutritive needs of the body and of the quality of our individual foodstuffs, both natural and manufactured, it has become more plain that a properly constituted dietary is of fundamental importance for optimum development and for the maintenance of health.

Many physicians and biochemists, who have followed the progress of discovery in this field, are convinced that if the knowledge which we now possess could be applied in the daily selection of food for every family in Europe and America, there would result in a single generation a wonderful improvement in bodily size, symmetry and vigour in the population. There seems little room for doubt that a marked reduction of disease would also be the reward of an effective dietary reform. The teeth, when they decay, are frequently the sources of focal infection, to which a score or more of serious human ailments have been referred. Possibly, also, an increased resistance would be acquired to certain infectious diseases. The quality of the teeth is in great measure determined by the state of nutrition of the child in pre-natal life and in infancy. The structure of the teeth and their environment are determined by the food supply. Many and serious as are the problems confronting Europe and America at the present time, none is more important than the application of the science of nutrition in the daily life of the people.

THE BASIS OF HEALTH

By MACPHERSON LAWRIE, M.A., M.B., B.Ch., Clinical Assistant Physician at St. Luke's Hospital for Mental and Nervous Diseases.

NUTRITION is the basis of life and growth. Without proper nutrition there can be no health, no normal function. It does not depend upon food alone. It depends upon food, upon oxygen, upon their circulation, and upon water, the medium of reaction. These essentials are interdependent one upon the other; they all partake in one process, that of nutrition.

Food is taken into the alimentary canal; it is acted upon by certain juices; it is broken up into fine particles which are absorbed into the blood. These are carried round the body in the blood-stream, each organ selecting from the circulating supply those particular elements suited to its purpose. It is no use carrying the end products of digestion to the organs unless they are accompanied by oxygen. No tissue can use them in its absence.

Oxygen is taken into the body by breathing fresh air. It is also carried round in the blood-stream. In its presence the body can use the food supplied for its energy, its growth and its repair. The circulation of the blood transports the food elements which come from the alimentary canal and the oxygen which enters through the lungs. By muscular exercise efficient circulation is maintained. Water is the medium of tissue activity. In its absence the chemical reactions of the body cease. Upon these factors depends the activity of our organs. In the absence of any one of them that activity is curtailed. They are all required to

maintain proper nourishment and proper drainage.

Therefore, when we consider nutrition, not only food, but the factors upon which its transportation and its use depend must share collectively our consideration.

Let us consider the food. Some years ago the energy value of the various food stuffs was worked out, the energy output of the body carefully measured, and conclusions were reached as to exactly what quantities of food were required by man. Upon this energy value the basis of diet was established. It was not very long before it was shown that you cannot base a diet upon quantity alone. It was found that animals fed upon a perfect diet as regards quantities, that is, upon food containing sufficient protein, fat and carbohydrate and a well-balanced supply of the known minerals, became ill and died. By, adding a little complete and natural food, such as milk, death was avoided.

The Right Food.

This fact is based upon hundreds of experiments carried out in almost every civilised country. By it, the proof was made that in natural food there are substances vital to life. These substances were named vitamins. There are probably very many substances in natural food and in unrefined food without which the body cannot prosper. The investigation of these accessory food factors is in its infancy. But what has clearly been shown is that you cannot tamper with natural food with impunity.

The power that built up the complex living organism man has also provided the essentials for his growth and maintenance. There are processes at work within the human body which we do not understand. There are minute chemical reactions which we are unable to follow. There are glands which pass into the blood secretions of profound importance. There are substances in food essential to our health. We do not know their composition. Their presence and importance have been demonstrated by experiment.

Not only can the growth and development of animals be impaired by their withdrawal, but their powers of reproduction and their normal sexual activity can be diminished. By unknown processes nature produces nourishment suited to all our needs. In her supply every essential abounds. Whatever elements vital to nutrition may be discovered in the future they will be found in plant life or in animals fed upon it. What is certain is that we must get sufficient of those various unrefined foods upon which ages of generations have relied for their development and their strength. As we depart from this rule so diseases will arise.

The classic examples, such as scurvy, have proved to us that definite diseases arise from definite deficiencies. But as we see them they are the endings of a process, the termination of a procession of symptoms often overlooked.

Deficiency Diseases.

To focus our attention too rigidly upon particular deficiencies and the disease caused by them, cramps our outlook—it centralises our mind upon disease. Instead we should learn the lessons which they teach. We learn that complete deficiency means complete disease. But we must learn that partial deficiency of any accessory food factor leads to impaired resistance, to general ill-health and to under-development.

Feeding experiments upon animals prove a great deal, but their early subjective symptoms are difficult to follow. It is probable that that sensitive internal glandular system which controls our bodies and our minds will suffer first. It will probably react early to defective diet. It may register some symptom through the mind ; a vague discomfort or a nervousness may be all. The causes of such in civilised man are difficult to prove by animal experiment.

To begin with, we refine our bread, to whiteness, throwing away half the quality of the wheat. Whatever may be said regarding the energy value and the vitamin value of this steel-milled bread, its production and its use is a definite departure from the habits of centuries. To base food upon energy values alone has been proved fallacious. In the wastings do we know what we throw away? Our knowledge is incomplete. May

not the future show that we discard many substances which to-day remain unknown? Substances which we are failing to provide in our manufactured substitutes. Are we not, perhaps, interfering rashly with this basic food of peoples? For we do not know for certain all those ingredients upon which its worth depends. Possibly, we cast away some little complex part formed to enable the complicated system of our glands to function.

Then we concentrate our sugar and consume it in quantities unknown in natural life.

In the last hundred years its use per head has increased by ten times. Apart from other considerations, it must upset the balance of nutrition. To-day we take into our system a fuel food in ten times the quantity which has been required for the evolution of man. Our digestive glands may be adaptable, but it is difficult to believe that during the last hundred years our metabolic processes have so changed as to allow our bodies to deal normally with this excessive intake of carbohydrate food.

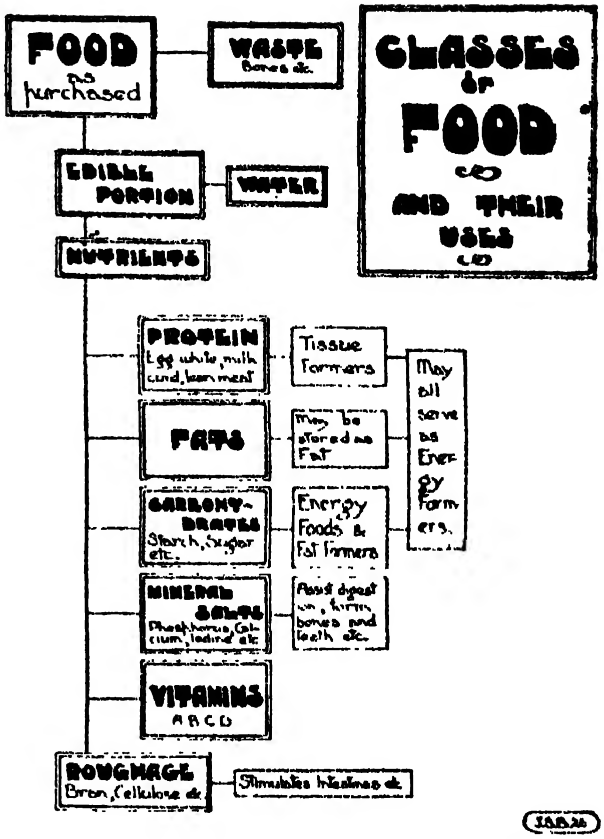
Excessive Fuel Foods.

Probably life to-day puts an increased strain upon the civilised being, but the powers of sustained activity existing amongst peoples throughout the world, in whose diet sugar in excess plays no part, is remarkable. With a minimum of muscular exercise in the fresh air, excessive fuel food may account for much of the restless, nervous excitability which is so prevalent to-day. Whatever metabolic process may be finally proved to be deranged, whether an exhaustion following excessive pancreatic activity, or an endocrine disturbance, or both, the fact remains that it is extremely common to find a high sugar consumption and a highly nervous temperament in conjunction.

Finally, for years we have poisoned our food. So alarming has this factor grown that the Government has taken steps to curtail it. But it has been found that a reasonable meal may contain twenty grains of boric acid besides other preservatives and colouring matter.

We know that much of the food to-day is refined and devitalised. The distinct departures from natural feeding which have occurred in the last sixty years are associated with distinct alterations in human development. Most particularly may we observe the dental decay existing to-day and the inability of a large percentage of mothers adequately to nurse their babies. It is associated with general poor physique throughout the nation; with enormous sales of drugs. The money spent upon advertising pills and tonics alone is immense. These things are taken in quantities which constitute more than aids to nature. They are taken to relieve pain and discomfort. They are taken to counteract apathy and failing energy, and they are taken in some form or another habitually by the vast majority of the population.

The money spent in the cake and sweet shops, and that spent later in the chemists upon purgatives, headache powders, and nerve tonics, proves that bad feeding is seldom the result of poverty, but that it is



Courtesy] [*"Diet for the Million," J. S. Bainbridge, M.Sc.* (*Williams & Norgate*)

THE FOOD WE EAT

due to ignorance and neglect. It exists throughout every class. Money is spent upon artificial products which are not food: upon delicacies which ruin our digestion; upon sweetmeats which upset the normal activity of our metabolic processes, and it is spent upon purgatives and drugs in attempts to counteract disordered function caused by the devitalised and concentrated diet of to-day.

Our feelings arise from the tissues and the organs of our body. *Disordered function leads to disordered feeling.* A distended stomach gives a feeling of discomfort. Intestinal disturbance may cause the pain of colic. Depression accompanies constipation; the dyspeptic feels irritable. It does not matter whether, for instance, it comes from a diseased joint or from a deranged gland, or whether the feeling is a definite localised pain or a vague consciousness of inability, the feelings, sensation, and awareness arise from organic origin. Most impaired and diseased tissues will register in some way their state upon the consciousness.

Disease is a process with a beginning. Disturbed function gives a warning, a warning disregarded or smothered by purgatives and drugs until disease step by step slowly develops into organised disorder. Our nervous system warns our brains. Our intelligence must guide our thoughts towards the cause.

Disease Factors.

Hypersensitive, restless and unhappy people exist to-day in every class, suffering from unaccountable depression, from loss of hope and spirit. The restless, discontented girl one sees too often. Hereditary factors account for some, starved youth accounts for more. Foolish feeding and unhygienic living remain the cause of most. Relying upon white bread and margarine, tea and sugar, cream cakes and potted meats: what otherwise can follow? Probably towards evening comes her first meal of any value in the day. By degrees we can watch her body starved of those elements vital to her health. Gradually she finds that she cannot concentrate her mind upon one thing for long. She becomes restless. She moves from one environment to another, seeking some satisfaction which will allow her to relax. Finding it nowhere, her restlessness increases, and with it comes an irritable, impatient mood. Presently, undefined and anxious currents disturb her sleep; and, in her broken sleep, she dreams;

THE FOODS OF THE UNDERFED GIRL

White bread and margarine, tea and sugar, cream cakes and potted meats—devitalised foods which form the diet of far too many working girls to-day.

THE NEED OF THE RISING GENERATION
The first necessity in children's diet is an abundance of milk.

distressing, frightening dreams. Gradually her restless, doubting spirit muddles her judgment. Advancing exhaustion destroys the equilibrium of her mind. Her power of attention is lessened ; her thoughts are mixed. Her confidence begins to fail. Her worries develop into anxieties. She believes that the eyes of others can observe clearly those failings which she feels about herself. Emotional reaction warps her natural conduct. Her mind accumulates a wealth of introspective thought, until one day, with unquenchable tension, comes relaxed control, and she breaks out into temper or may collapse in tears.

The more serious symptoms may not occur. At some point the process may remain and fluctuate, causing general unhappiness and loss of spirit. But those who live upon a minimum of vital food exist with small reserve. They are pushed, at times, very near the precipice which leads to complete nervous exhaustion, *the first signs of which may be restlessness, sleeplessness and mental irritability.* If these early warnings are neglected, the process will advance, for the beginning is often very, very slow ; the exhaustion may suddenly appear, and the climax may be years of suffering.

These cases are common to all classes. They are breaking down mostly because nutrition is at fault.

Perhaps, some ductless gland is unable to pick out from the food supply the elements required for its proper work, because in that circulating food these particles do not appear. They have been cast away, or burnt, or chemically destroyed before we eat our food.

Whatever activities in life we follow, our nutrition must be regulated to our particular needs. But in every case it must be based upon those four interdependent essentials ;

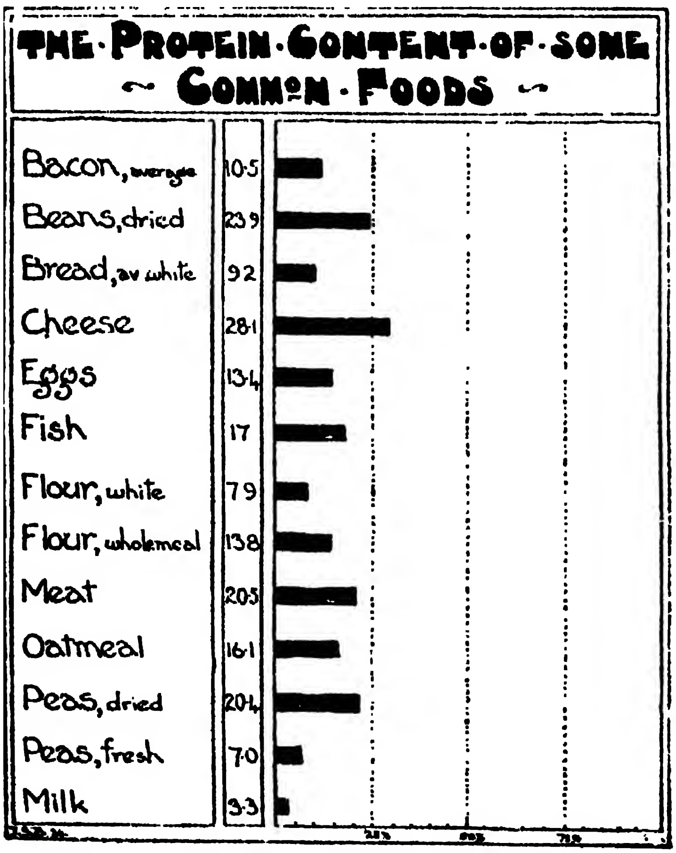
proper food, oxygen for its use, water for its medium, and exercise for its circulation. Without these, normal nutrition is impaired.

Indispensable Food Elements.

There can be no proper health without proper food. We do not understand the complicated living machinery of our body. We do not understand all the peculiar elements it requires for its use. What we do know is that it has evolved and been built up through countless ages upon nourishment suited to its function. We also know that that supply has recently been directly interfered with by chemicals and by machines. You cannot criticise the advocacy of a diet based upon nature's provision. To base it upon any other thing seems foolish. To disapprove because some individuals, already diseased, are unable to digest any but softened and refined food, is wrong. To follow such a policy is deliberately sacrificing youth. Its outlook is despair.

We want to see a generation growing up with fine bodies and strong teeth; happy and contented, able to tackle with clean bodies and clear minds the problems of life. We cannot expect to see this if we base their diet upon the abilities and habits of a generation which is spending fortunes upon drugs. Our concentrated, refined diet is constipating. We must give to them food which they must bite. Nourishment upon which they can develop, and natural, unrefined food upon which they can maintain the tone and the activity of their bowel.

Throughout the nation the standard articles of diet are universally employed. They form the basis of family feeding. They are consumed by the child, the fully grown and the aged. National diet must be based upon the wants, the needs and the necessities of the young. It must be based upon the experiences of the centuries. If we give youth the devitalised diet of to-day, we are leading it directly along the path which has led us to poor development, wretched teeth, dyspepsia, constipation and colitis.



Courtesy] [" *Diet for the Million,*" *J. S. Bainbridge, M.Sc.* (*Williams & Norgate*)

THE TISSUE-FORMING FOODS

The average protein content per cent. of some well-known foods.

Our task is to correct the mistakes of yesterday and to-day and to give to the rising generation every chance of health.

We cannot await the unveiling of more mysteries. There is nothing to be gained by that. Experiments have demonstrated vital substances in natural food. That is the lesson we must learn; that is the basis of our knowledge. What they are, how many exist, how they perform their duties, are questions for the future.

At present, we must realise that when we refine or concentrate our food we tamper with substances of which we have small knowledge. The error made in basing diet upon energy alone is clear. It may be followed by a

sequel if we ignore the unknown possibilities which time may prove.

Our endocrine glands which control our growth, which influence so profoundly our sex development and our sexual life, may require some vital substance for their normal function which we are failing to provide.

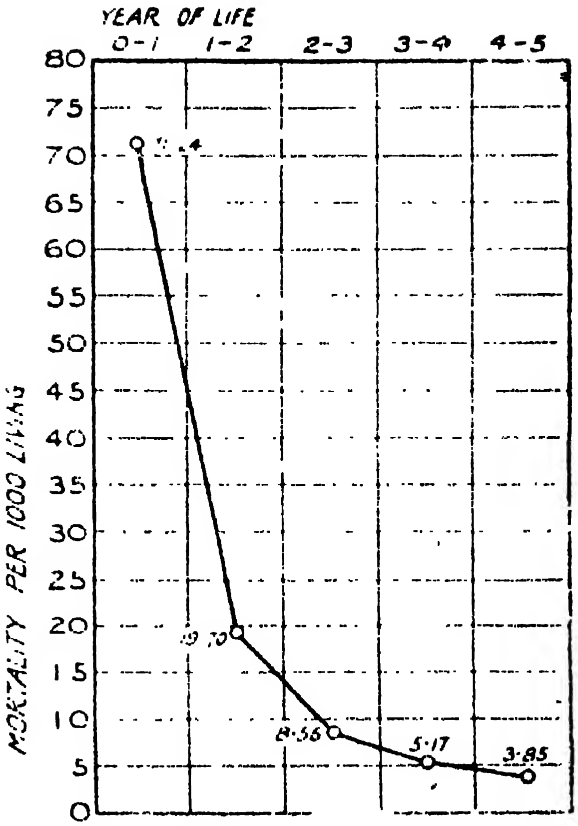
When trying to subdivide the elements in food, when trying to concentrate its properties, let us remember that by relying upon the varied, whole and unrefined supplies of nature we can be certain that we procure for every organ in our body every essential it demands. It is probable that many of these nervous states considered due to hereditary weaknesses or to the strain of life to-day, arise from sixty years of unnatural feeding, and that with a correction of this basic factor they would slowly disappear.

Without efficient nourishment our body weakens. Sooner or later our lowered resistance will be unable to conquer the invading germ. Some spot will give way, for as we diminish the strength of our defence, so *most certainly* will we fall a victim to the germs around us. Somewhere will a process of disease commence to cripple function. Insidiously disease will make its mark, will set its seal upon us. Unknown toxins may circulate in the blood from unsuspected foci of infection. We cannot examine every corner of the human structure, but we can see that those channels of drainage, the kidneys, the skin, the lungs and the bowels, are flushed, clean, and clear; and by adequate nutrition and its drainage we can help ourselves.

Weakened Resistance to Disease.

At conception, hereditary factors are stamped upon the coming child. From then onwards the influences of environment exert their sway. There is no influence more important, over which we have more control, than nutrition. Firstly, through our mother's blood; secondly, by her care; finally, by our individual effort, can our lives be made or marred by this one factor.

The first critical period is that before our birth. We are dependent then entirely upon the nourishment and purity of our mother's blood. Through it alone can we be nourished, can grow, can live. From it alone can we obtain those elements we require for the development of our complicated form. No influence comes to us except through her. Her blood is the environment of our existence. As she ministers to her own health, so is the coming child administered to. As she poisons and exhausts her own body, so may that body growing within her suffer.



THE CRITICAL PERIOD IN A CHILD'S LIFE

Showing the high death-rate of children in England and Wales in the first year of life—largely due to unnatural methods of feeding.

At birth begins the second phase of life. Small and helpless, the baby strives to live and to obey the physiological laws of nature. It opens its lungs to obtain the oxygen. It opens its mouth to secure its food and it stretches its limbs in exercise. Normally, nature supplies a complete food which it can digest. There is no perfect substitute. No milk from another species, however carefully prepared, can replace adequately breast

milk for the infant. The mammary glands of the nursing mother will select from her blood just those things needed by her offspring, and they will select them in correct proportions. By artificial feeding we are giving to the baby a form of food which it is largely unable to digest. We are depriving it of the natural exercise for its mouth and jaws. We are paving the way to dental decay, and we are providing a nourishment most likely contaminated with micro-organisms.

The first year is indeed the second crisis of our lives. Half of the children dying under the age of fifteen die under the age of one. In Professor Starling's *Physiology* we can read: "There can be no doubt that of the children dying during the first year of life, four-fifths are murdered by this unnatural method of feeding."

In the next chapter, Nature builds up the body. It endeavours to equip it with those qualities most suited to survival. In some animals it develops muscle, in others speed. To man, Nature gives increased intelligence. It develops slowly, hence man's lengthened youth. During this time he is protected from harm; is provided with the essential wants of life, so that he can give his whole time to its development. By touching this and that the baby begins to understand the complex nature of his surroundings; he becomes able to distinguish their differences and to appreciate how the various objects of his interest concern his person. Curiosity urges him on. He discovers what things give him pleasure, what bring pain. Slowly, as he progresses, he is able to recall for his use the experiences of his past. He becomes able

Specialised Development.

NATURE'S COMPLETE FOOD

The baby obtains from its mother's milk just those substances necessary for its growth, which it cannot find in correct proportions in any other food.

to look ahead and make a plan, and learns so to regulate his activities as most surely to attain his goal. So, gradually, he builds up from his experiences knowledge to guide his instincts, knowledge to adapt his conduct according to the custom of his time.

From birth to fourteen this chief asset, which Nature has given to man, develops. During these years he builds up the scaffolding of intellect. As he passes through his schools he must have an alert and attentive mind if he is to profit by his teaching. The hungry animal will not produce muscle, it cannot develop speed. The undernourished child remains dull and backward. The child from nine to thirteen requires as much food as the grown man. We do not know those finer elements it wants, but they exist in milk and wheat. In quantity, supply may be sufficient; in quality it is often poor, unbalanced and refined. It cannot build upon white bread and margarine and sugar. It is estimated that 20 per cent. of the children attending school in this country are under-nourished. It is estimated that in England and Wales half a million school children, though not specifically feeble-minded, are too dull and backward mentally to derive full benefit from schooling. In parts of Germany, after the war, there was an unusual opportunity for studying the mental capabilities of children who had suffered from three years' of poor feeding. Reports show that the percentage of retarded children doubled. Teachers agreed that children had poorer powers of concentration and attention and had poorer memories than at normal times. It has been shown that boys and girls given half a pint of milk and a biscuit twice daily showed more alertness and attention than before they took the milk.

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THAT RAILWAY BUN!

An illustration of the large appetites which are a normal feature of growing youth at its critical stage—the correct choice of food at this period is of vital importance to future years.

Before the child can arrive at maturity he must pass through a crisis—the third—the most important of them all. However sure

the foundation, however sound the upbringing, neglect here is fatal to full development.

Sexual Development.

The urgency of these years from twelve to nineteen cannot be exaggerated. Upon them depend the capability and the confidence of adult life. The physical body is establishing its sex. The boy becomes a man, the schoolgirl becomes a woman; developing instinct is expanding both the body and the mind. It is producing the deepening of the male voice, the enlargement of the female breast. It is opening up new worlds of thought, new meanings are being read into the surroundings. It is giving rise to fancies and fears, to doubts and strange longings.

Lonely, fantastic, ambitious desires are buried too often in the secret chambers of the heart. They cause behaviour falsely understood by the parent and the child alike. The child becomes assertive or timid, restless and excitable, moody and irritable, according to its type. Upon development now depends the welfare and reproduction of the species, Nature's prime concern. Upon development now depends the ability of the future mother to nurse her child. *Complete development of the female breast is vital to a healthy race.* It is the indication of standard vitality. The indication of a virile stock. An indication of normal mature development.

During this short span of life, the physical development completes itself. The stress and strain of adolescence puts a demand upon the body unequalled in after life. Activity reaches a greater height during this stage of life than at any other. The output of carbon-dioxide should normally be larger. The call for nourishment is incessant, and must be met by an abundant supply. The child between nine and thirteen requires as much food as a grown man; between fourteen and nineteen it requires more. It cannot be left to chance. Crippled development now is laying the foundation for a future tormented by a nervous lack of confidence. Failure in efficient supply means failure in development, enfeebled function being the inevitable result. There is no age at which we are normally more sensitive and open to suggestion. *There is probably no one factor which contributes more largely to nervous instability in later life than poor nutrition during this time when we require all our strength to adapt ourselves calmly to those combined changes which perplex and emotionally disturb the equilibrium of our minds.*

Three ages we have called the critical of life. They are the chapters when foundations are laid; chapters when the individual is dependent upon the care, knowledge and guidance of those older than himself. They are chapters most profoundly influenced and controlled by secretions from our glands. Normal height and weight, growth to sexual maturity, with its mental and physical manifestations, all depend upon the harmonious interacting normality of our endocrine system. It is upon a generous beginning that the best chance in life depends. As the various stages of development appear upon the horizon their growth must be provided for so that each may expand to full maturity. The child's life is urgent to itself, it is not balanced with reason and with patience. Its welfare is an urgent necessity to the State. We must not wait until we see our children failing to succeed. We must not watch them nervous, irritable and weakened until some microbe cripples their lives or takes them from our sight. We must not await that first consumptive cough to haunt us for neglect.

That resistance to disease can be greatly strengthened by good feeding is a fact. That growth, sexual stability and efficiency can be influenced greatly by nutrition is not doubted. We can beg the parent to seek advice, to learn the facts, and act.

For instance, how many parents know whether their child at school is getting margarine or butter, although the difference in their food value is tremendous?

We know that there are glands within the body which influence our growth. We know

The Glands.

that, deprived of the vital accessory food factors, an animal will cease to grow. We know that these glands are composed of cells which

[Topical

A FOOD PROBLEM OF THE FUTURE
Harmless preservation and safe transport of our food are essential if it is to reach us whole and unrefined. Meat preserved in freezing chambers during transport is here being handled at the Royal Albert Docks.

produce by their activity something which stimulates growth and function. Their activity directly or indirectly depends upon nutrition. Unprovided for, their activity is deranged, their function is disturbed, and normal expansion does not occur. We know that our endocrine system is composed of various glands, which pass into the blood secretions or hormones that control and regulate the metabolism of the body.

They should function as a whole, harmoniously together. The activity of one is influenced by that of another. The impairment of one may be partially compensated for by increased functioning of another. How they influence one another we do not know. How exactly their intimate association functions, we cannot see ; and upon their individual contributions to the whole, we speculate.

What we do know is that the importance of their healthy, balanced function is immense ; that they profoundly influence our metabolism, our growth and our active sexual life, and that their disorder can produce some of the most pathetic forms of human life. To sell their extracts publicly by exciting promises is highly dangerous. We cannot tell what interaction may arise or what bodily disturbance may occur. *The sanest way to maintain their normal function is by correct nutrition.*

We do not fully understand the complex composition of our food, but nature has fashioned in whole and unrefined food every essential for their use. Possibly the connection between these glands of internal secretion and those vital substances which are known to exist in whole and natural food is the fundamental secret of normal function.

The problem for the future is the supply, the harmless preservation and the safe transportation of whole and unrefined food. By this means alone can we be sure that we do not interfere with processes which we do not fully understand. To interfere with, refine and concentrate our food seems madness. Advertisements of artificial foods, of

drugs, of some new admixture from the glands, abound. Together side by side they teach us much. The writing on the wall seems clear. These refined products are sapping the vitality of the race. Civilisation is undermining the basis of its growth.

Breeding should be true to type and definite of sex, with distinctive characteristics. To-day, it is not. Immature growth and slimness are confused. Many girls grow up with bodies unfitted for the adequate nursing of a child. These are signs of deeper things. The ductless glands have not been able to produce mature development. Impaired general and sexual function must result.

Altered nutrition appears a fundamental cause. *Feeding is a basic factor in breeding which we can control.* We must circulate through our bodies the foods they need and the oxygen for their use. Upon the future mothers depends the welfare of the race. Not only is their mature development and health of supreme importance to the reproduction of the species, but they constitute a force which more than any other can influence public thought and habit.

The hope of future health rests with the girls of to-day. They in their thousands take their midday meal in our public shops. In their thousands they select the food for the home. What they demand will be provided, what they ignore will quickly fall from favour.

Never have they had more liberty and freedom, more influence and power. It will increase. We ask them to use it to establish a healthy race, to promote a universal sense of pride in health, to make its possession a part of individual self-respect; by so doing they will contribute to the nation an immense benefit. With freedom comes responsibility; this matter is largely in their hands; it is their duty to perform their task, to demand whole and natural food, to exercise their bodies in the open air to enable them to use it, to build up a standard of physical development and health which will become the ambition of us all to reach.

FOOD AND ENERGY

By S. G. WILLIMOTT, Ph.D., B.Sc., A.I.C., Government Analyst and Lecturer in Chemistry to the Government of Cyprus.

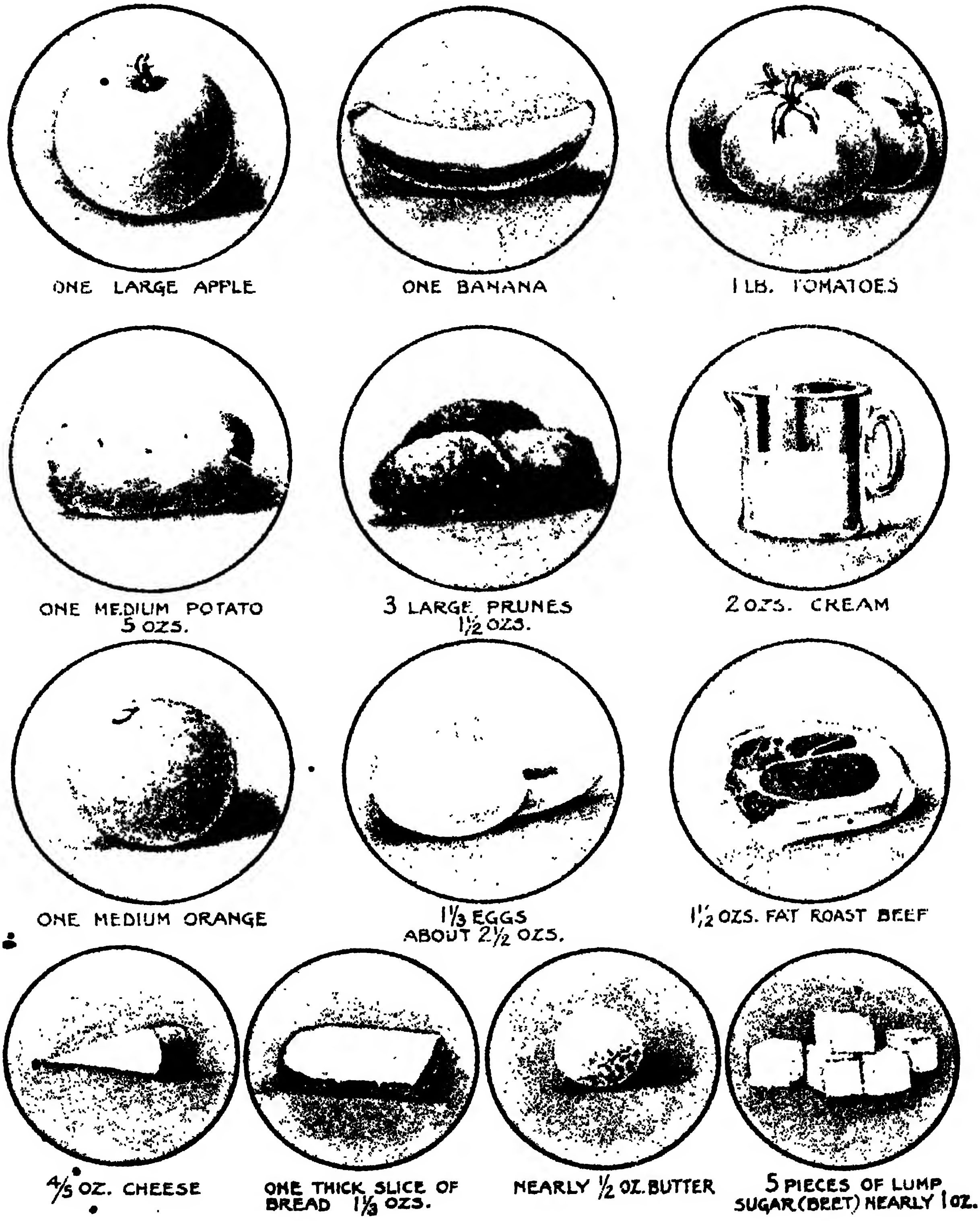
FOOD is consumed for two main reasons. Firstly, to supply the necessary material for the growth of new tissue in the young child and to replace wear and tear in the adult. Secondly, to supply energy for the work the body has to do, and heat to keep it warm. In forming new tissues and in maintaining them, food functions as a builder and repairer; in providing energy and heat it serves as fuel. In the adult only a comparatively small part of the food taken is required for the work of maintenance, the greater part being used as fuel.

The Human Machine.

The conventional analogy of the human body with a steam engine at work is helpful and in some respects the similarity is striking. For example, in the human machine the energy of the food appears in the form of heat and mechanical work just in the same way as does the energy of coal in the case of the steam engine. Moreover, both the human body and the steam engine are warmer than their surroundings and are capable of movement and the transport of loads. But it is doubtful if the analogy holds further. Firstly, the human body is a more efficient machine than the steam engine, in that it can transform as much as one-third of the total latent energy of the food into work as against one-fifth in the case of the steam engine. Secondly, the human machine is self-supporting, its wear and tear being made good out of the material supplied in the food. Thirdly, it is more adaptable than the mechanical engine and has the power of storing up a reserve of food energy upon which it can draw in time of emergency.

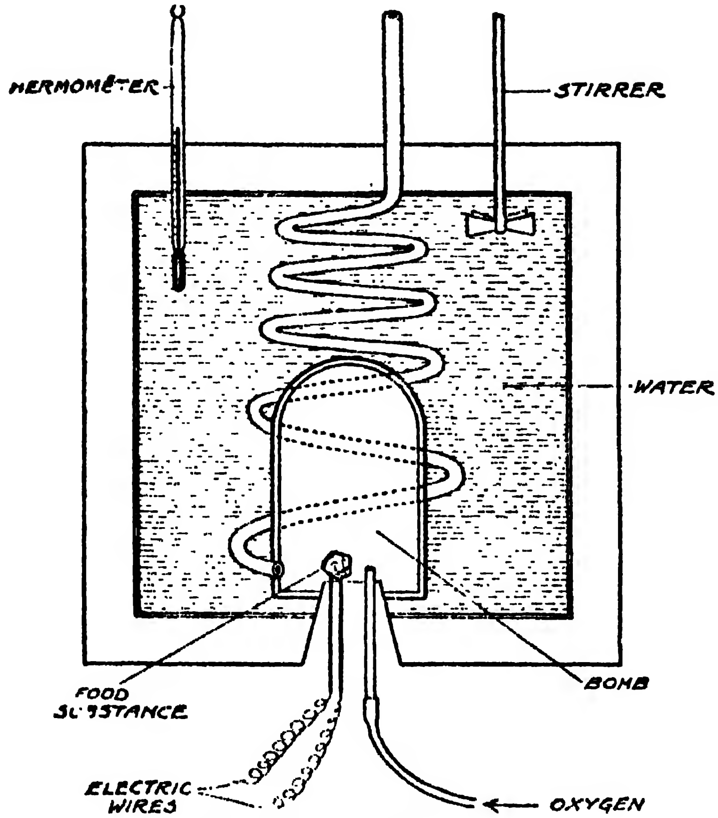
The constituents of the diet of man and animals fall into the following distinctive groups:—

Proteins, or flesh formers; Carbohydrates;



ENERGY VALUES OF SOME COMMON FOODS

Indicating the different quantities of some well-known foods required to make up the same calorific value.



THE BOMB CALORIMETER

The food is ignited electrically in oxygen, and the heat given out during burning is measured by the rise in temperature of the surrounding water.

Fats—known also as the "proximal principles," supply energy.

Minerals; Water—do not supply energy.

Fat-soluble and water-soluble Vitamins.

Protein and Energy.

With the vitamins excepted, the relative proportions of these groups in any foodstuff can be determined by chemical analysis. With the development of our knowledge of the chemical composition of food, the question of the supply of protein and energy-forming material in the diet has received considerable attention at the hands of investigators, and was for long regarded as the most important problem in nutrition. In the light of much new knowledge we now know that other substances, such as vitamins and mineral salts, are equally important.

Well-Balanced Diets.

For a diet to be well-proportioned or "balanced" the food must not only supply all the above principles, but it must supply them in the right proportions. For example, a satisfactory diet must contain a certain minimum quantity of protein and the proportion of carbohydrates to this should be approximately as six to one. To express this important relationship the term "nutritive ratio" is used. It is costly both in health and money to depart widely from this ratio in planning human dietaries or the rations of farm animals.

Again, the energy-forming starches, sugars, and fats, although to a large extent interchangeable, are burnt to better advantage in the body when a certain ratio is observed between them, *i.e.* about ten parts of carbohydrate to one of fat. If all the energy of the food is in the form of fat, the fat is incompletely oxidised. "Mixed with carbohydrate," says Plimmer, "it is as if fat burns with a clear flame, but if there is too little carbohydrate, it burns smokily."

For practical purposes it is useful to remember that carbohydrate is quickly burnt up in the body, while fat, being oxidised more slowly, is a more sustaining fuel. When a surplus of carbohydrate is present in the food the body is able to transform and store it in the form of fat.

Energy Values.

The energy value of food is measured by the heat unit, the "caloric," which is defined as the amount of heat required to raise the temperature of 1 kilogram of water 1° centigrade. For the determination of these energy values a special apparatus is used, called a "bomb calorimeter." The energy given out by a foodstuff in the calorimeter is greater than when it is burnt in the body. This is explained by two factors: cellulose when present in the food is not burnt by the body, while proteins are incompletely oxidised to "urea," a waste product which is excreted in the urine.

DIET AND HEALTH

The physiological energy values of food are usually accepted as follows :—

1 gram of protein	yields 4·1 calories.
1 " fat	" 9·3 "
1 " carbohydrate	" 4·1 "

With this data and the chemical analysis of a food the energy value is readily calculated.

In the following list, which in no way claims to be exhaustive, are set out some of the principal foods which supply energy in human dietaries. Energy is most cheaply supplied in the form of carbohydrate. Consequently we find cereals, certain pulses, dried fruits, nuts and dairy products of particular use for this purpose. The energy values have been calculated from the composition of the food, correction being made for the digestibility where this data is available.

In selecting foods for dietaries the following conditions should be carefully satisfied :—

1. The provision of sufficient food energy.
2. The provision of sufficient good protein.
3. The provision of certain minerals and the necessary vitamins.
4. The balance between the different factors.
5. The serving of meals in a wholesome and attractive form.
6. The necessity of securing variety.
7. Adaptability to individual requirements, *e.g.* age, climate, amount of physical work.

TABLE OF ENERGY VALUES

	% Carbohydrate.	Protein.	Fat.	Energy Value in Calories per 100 grams.
Cereals				
Bread, white	50	7·0	1·0	230
Bread, wholemeal	55	6·3	1·0	235
Arrowroot, Tapioca	88	0·2	—	340
Rice, unpolished	80	6·8	0·6	340
Barley	78	8·2	1·1	330
Oatmeal	67	12·0	8·3	300
Macaroni, average	76	13·4	0·9	350
Pulses				
Beans, haricot	62	17·2	1·1	300
Beans, broad, e.p.*	55	15·0	1·3	270
Peas, fresh garden, e.p.	16	6·0	0·4	95
Roots				
Potatoes, e.p.	19	2·0	0·1	80
Parsnips, e.p.	16	1·6	0·5	73
Fruits				
Dates, e.p.	68	1·4	0·2	265
Raisins	65	2·2	0·3	250
Currants	42	1·7	0·3	165
Prunes, e.p.	34	2·5	0·2	130
Bananas, ripe, e.p.	21	1·2	0·1	85
Nuts				
Chestnuts	48	3·0	1·9	200
Almonds, e.p.	16	18·8	55·0	590
Walnuts, e.p., dry	14	13·6	60·0	650
Brazil nuts, e.p.	8	13·0	70·0	665
Cocoanuts, flesh, e.p.	8	4·2	49·0	440
Also earthnuts, pecans, Barcelonas, hazel, and pinenuts.				
Meat and Fish				
Beef, medium fat, e.p.	—	19·0	19·0	195
Mutton, medium, e.p.	—	16·0	33·0	335
Bacon, smoked, e.p.	—	10·5	65·0	600
Duck, e.p.	—	9·8	37·2	350
Herrings, e.p.	—	18·5	12·6	170
Salmon, e.p.	—	15·0	13·0	165
Sardines	—	23·0	16·0	220
Dairy Products				
Cheese, American	0·3	28·0	34	400
Cheese, Cheshire	0·9	23·0	34	380
Cheese, Cheddar	4·0	25·0	33	385
Butter	—	1·0	85	765
Margarine, average	—	0·2	85	760
Cream, centrifugalised	—	1·8	45	400
Cocoa	—	20·5	24·8	295

*e.p. edible portion.

THE VITAMINS

By S. G. WILLIMOTT, Ph.D., B.Sc., A.I.C., Government Analyst and Lecturer in Chemistry to the Government of Cyprus.

IT is now realised that to sustain life and maintain the individual in a state of health, something more is required in the diet than a minimum of protein to replace wear and tear in the body, and a sufficiency of carbohydrate and fat to supply the necessary energy. There must also be present sufficient water and a certain number of indispensable mineral salts. But it was not suspected that any other food constituents

Courtesy] [National Milk Publicity Council

THE EFFECT OF MILK IN THE DIET—BEFORE

Six children, fed on an ordinary diet, showing signs of mal-nutrition, including a mild degree of rickets (seen, for example, in the protruding abdomens).

were essential to life until the first decade of the present century. Perhaps the reason these substances were not detected sooner was the fact of their presence in such minute quantities in natural foods. Although valueless in themselves as a source of energy because of their existence in such small amounts, they are indispensable for the health, growth, and life of man and the lower animals. Whenever any or all of them are removed from the diet, either deliberately in the animal experiments of the scientist, or by the exigencies of war, famine, and poverty, disastrous results follow. To designate substances of this nature, which are independent of the provision of energy, the term "vitamins" has been coined.

Chemical Mysteries.

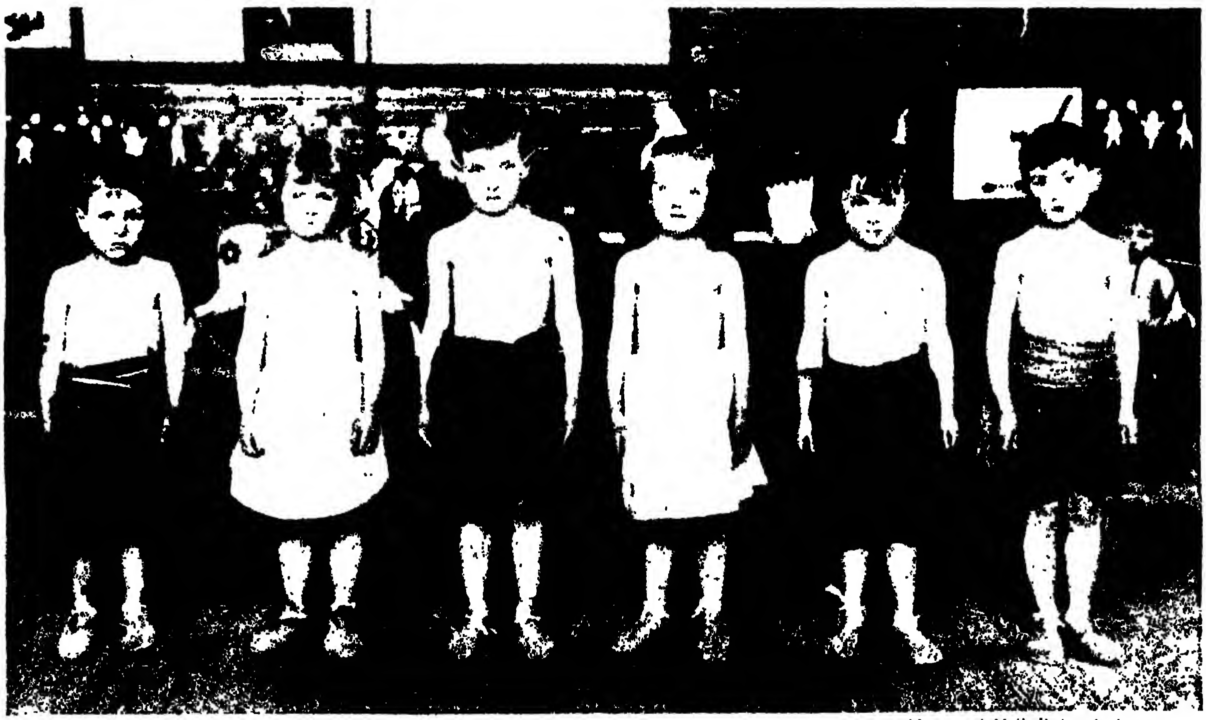
Substances of this nature cannot yet be detected by chemical means, and in spite of fifteen years' continuous research they have baffled all attempts at isolation, Consequently, they remain chemically undefined while their actual number is still a matter of debate. Even their objective existence has been challenged from time to time by sceptics, but further work has convincingly disposed of such criticisms. The mode of action of the vitamins in nutrition also remains unknown, but it is thought that they act in one of two ways: (1) either they are required in minute amount for the formation of tissues, or (2) they act as catalysts (or aids to the chemical processes.) The latter theory, perhaps, appears to be the more feasible. But incomplete as our knowledge is, the objective reality of the vitamins has been fully established by experiment directed towards the effect of their absence.

They are all products of plant life, and, with the exception of the anti-rachitic vitamin, man and the lower animals are entirely dependent on the plant world for their supplies. Much patient and careful work has now provided us with a fair idea of

what foodstuffs contain them and those in which they are naturally deficient, or have been rendered so by the artificial processes of modern manufacture.

It is perhaps not surprising that the idea of this small but extremely important family of vitamins should have caught the popular imagination, and signs are not wanting that the discovery has been exploited in many directions. It is therefore desirable that the fundamental facts should be readily available and should be known to the public. There is now sufficient evidence to say that the individual will obtain a sufficiency of the different vitamins so long as his food is reasonably varied and has not been subjected to destructive influences, inadvertently by nature or ill-advisedly by the hand of man.

There has been much confusion in arriving at a satisfactory nomenclature for these newly discovered substances. Hopkins originally designated them "accessory food factors," but this term was considered to be unsatisfactory, suggesting as it did a subordinate rôle and possibly a confusion with condiments. Later in 1913, the more picturesque word "vitamine" was coined by Funk to designate the potent anti-beri-beri substance he had succeeded in isolating from rice bran. But the implication of an "amine" (a definite class of organic compounds) essential to life proved to be unwarranted, and to avoid this difficulty McCollum next proposed the use of the algebraic terms "fat-soluble A" for the anti-xerophthalmic growth factor and "water-soluble B" for the anti-neuritic substance. These terms were widely used until Drummond proposed the modified form "vitamin" to designate the entire family of unknown food factors, the final "e" being omitted to avoid the implication that the substances were of known constitution. The several known vitamins are then lettered off according to the alphabet, *e.g.* vitamin A, vitamin B, etc. Many other terms have been put forward at different times, *e.g.* "complettin" by the German chemist Ragnar Berg, and "torulin" by Moore, but all these are now



Courtesy] [*National Milk Publicity Council*

THE EFFECT OF MILK IN THE DIET—AFTER

The same children nine months later, showing the marked improvement, physical and mental, due to the daily addition of a pint of milk to the diet.

SIR F GOWLAND HOPKINS
The famous English scientist who was one of the pioneers in the discovery of the action of vitamins

likely to pass into oblivion. The nomenclature of Drummond, which is simple and connotes no known structure for these substances, has now come into general use.

RISE OF THE VITAMIN THEORY

Several hints are to be found in literature of the existence of substances which would to-day undoubtedly be classified as vitamins; at the same time many empirical observations of antiquity find their true interpretation in the light of the modern vitamin theory. For example, it has been known for centuries that the juice of the orange and the lemon and certain fresh vegetables were a specific in the cure of scurvy. Approaching modern times, we find the idea of certain constituents of food endowed with marked power to stimulate growth engaging the fertile imagination of Mr. H. G. Wells, who treated the theme with effect in his novel *The Food of the Gods.*

The earliest experimental studies appear to have been those of Lunin in 1881, working in Germany. Lunin was endeavouring to solve an entirely different problem, viz., the effect of adding mineral salts to the diet of mice fed upon pure synthetic foodstuffs. Another group, acting as a control, received fresh milk alone. It was found that, whether minerals were added or not, the animals died, but the control group receiving milk flourished. From these facts Lunin rightly concluded that "other substances indispensable for nutrition must be present in milk besides casein, lactose, fats and salts." Unfortunately, this brilliant deduction fell on barren ground, for its significance does not appear to have been realised either by Lunin himself or by his scientific contemporaries. Perhaps the discovery was made out of its time or perhaps the idea was too revolutionary towards current views on nutrition. However this may be, some thirty years were to elapse before the work of Professor F. Gowland Hopkins, the pioneer of vitamin research in this country, established the theory of the existence of substances which we now classify as vitamins, upon a sound experimental basis.

Experiments of Hopkins.

Hopkins' original conception was inspired by clinical observations in hospital. His interest was aroused by a certain curious state of nervous weakness amongst women clerks, a condition which almost invariably improved in hospital, apparently without any very definite treatment. Such patients had previously subsisted upon a characteristically monotonous diet in which white bread, tea and sugar bulked largely. Reflection upon these facts led Hopkins to suspect a dietetic origin for this vague complaint, and he showed conclusively that the conventional theory of an adequate diet failed when put to the test of experiment. He was thus led to the conclusion that substances other than proteins, carbohydrates, fats and mineral salts were essential to life. These substances of unknown constitution he provisionally termed "accessory food factors," and such were shown to be present in milk and yeast. Thus Hopkins wrote in the discussion of his results: "If the attachment of such indispensable functions to specific accessory

constituents of diets is foreign to current views upon nutrition, so also is the experimental fact that young animals may fail to grow when they are absorbing daily a sufficiency of formative material and energy for the purpose of growth." The rise of the modern theory of vitamins may be taken as starting from this point.

Independent confirmation of Hopkins' results was at the same time forthcoming from the work of Stepp in Germany. He showed that mice which could live well for months on food such as bread made with milk, were unable to survive longer than one month when restricted to the same diet after it had been thoroughly extracted with fat solvents. When, however, the fatty extract was restored to the extracted food, it became adequate again for normal nutrition. By such experiments, Stepp was led to suspect the existence of unknown indispensable factors in the food. Although he failed to identify them with any known lipoids, to which class of substances he thought they belonged, he was right in believing them to be associated with such bodies.

"Fat-Soluble" and "Water-Soluble."

The next fundamental discovery in vitamin research, the differentiation of fat-soluble and water-soluble vitamins, was now made in America. Soon after Hopkins' contributions appeared, Osborne and Mendel narrowed down the source of these accessory substances to the fatty portion of the milk, and later discovered that cod-liver oil was a highly potent source of the growth-promoting vitamin.

About the same time (1913), McCollum and Davis were studying the effect of growth on certain fatty substances soluble in ether. Working on the lines of Stepp's earlier investigation, these authors found that growth ceased in sixty to eighty days on a diet from which all ether-soluble substances had been extracted. On adding to the diet ether extracts of egg or butter fat, growth was re-established with the successful production and rearing of litters.

Up to this point the results of the two leading American schools seemed to require the existence of only one accessory food factor. But the experimental diets used by investigators at that time could not be regarded as scientifically "pure." Thus Osborne and Mendel used as their supply of mineral matter a so-called "protein-free" milk in place of pure salts, while McCollum and Davis employed a commercial preparation of lactose. The latter investigators now discovered that birds suffering from polyneuritis as a result of being fed on an exclusive diet of polished rice, could be cured by the addition of commercial lactose. Thereupon, McCollum and Davis modified their experimental diet for rats, replacing lactose by dextrin, when no appreciable growth resulted, even when the diet contained 5 per cent. of butter fat. In the same way, when the protein-free milk of Osborne and Mendel was replaced by synthetic salt mixtures, no growth was manifested even though the diet contained ample amounts of butter or egg fat. Only by postulating the existence of a second distinct factor, present in the lactose in the one case and in the "protein-free" milk in the other, could the experimental facts be explained. Two substances, then, are necessary for the normal nutrition of the rat, one soluble in water, the other soluble in fat. Pending a knowledge of their chemical nature, McCollum named these unknown factors "fat-soluble A" and "water-soluble B."

Corresponding to the two vitamins, two distinct conditions of deficiency disease were recognised. Deficiency of fat-soluble A usually resulted in the typical picture of xerophthalmia, an eye disease commencing with hæmorrhage of the lids, involving the cornea, and in extreme conditions, resulting in the bursting of the eyeball itself. A parallel condition in man was observed some time before its analogue was experimentally produced in the rat. Mori refers to some 1400 cases of xerophthalmia amongst infants of two to five years which occurred in Japan from 1905-7, and Bloch describes some fifty cases in Copenhagen during the years 1912-16. Deficiency of water-soluble B was characterised by certain degenerative changes

[E.N.A

A CAUSE OF BERI-BERI

A meal of rice—a staple food in the East. The polishing process removes the essential Vitamin B and results in beri-beri.

These birds were fed on the boiled rice garbage of the prison, and many of them died with degenerative changes in the peripheral nerves. From this chance observation, Eijkman was inspired to conduct systematic feeding experiments with pigeons and fowls. Some received rice in the natural state with the husk attached to the grain, some half-peeled rice which still retained the pericarp or "silver-skin" and germ or "embryo," and some polished white rice. The disease developed only in those birds receiving polished white rice and was cured by the addition of the whole grain, the half-peeled rice, or the rice polishings.

Eijkman's results showed definitely that rice, which had lost its silver-skin, would produce the condition of nerve degeneration which he called *polyneuritis gallinarum*. This condition he rightly considered to be analogous to human beri-beri. Eijkman's results were extended to cover sago, tapioca or peeled barley. In collaboration with Vorderman, Eijkman now confirmed his findings by feeding experiments on some quarter of a million Javanese. In spite of all this, he did not succeed in giving the true interpretation of the facts he had established. Much further painstaking research, chiefly on human subjects, in different institutions in the Far East, of which mention must be made of Fletcher's work in the Malay States, pointed to a dietetic origin for the disease. These investigations culminated in Fraser and Stanton's revision of the whole field. Working in the Malay States they virtually established the origin of beri-beri as due to

in the nervous system producing polyneuritis in birds and a somewhat similar condition in rats.

While these facts were emerging, chiefly as a result of the animal experiments of laboratory workers, evidence of another kind but leading to the same conclusions was accumulating from the clinical observations of physicians in different parts of the world. The evidence was often confusing, largely because it was easier to look for a positive than a negative cause, and because the simple interpretation of the data available was seldom considered. In the case of beri-beri a bacterial origin was repeatedly sought in vain, and the fact that rice had been robbed in the milling process of some important constituent whose absence was the cause of the disease, was only slowly accepted.

Clinical Evidence.

This new line of evidence may be regarded as starting with the work of the Dutch physician, Eijkman, who investigated the disease of beri-beri in 1897. Eijkman, who was medical officer to a prison in Java, noticed that some of the fowls on the prison establishment showed symptoms of paralysis strikingly suggestive of those of his patients.

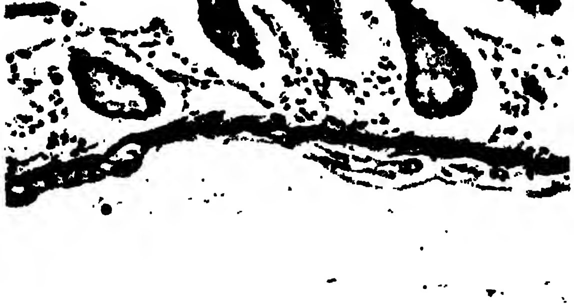
the absence of some unknown chemical substance in the food.

Water-Soluble B.

The anti-beri-beri or anti-neuritic substance and the water-soluble B vitamin of McCollum were now generally regarded as being identical, and until recently this view was widely adopted, but since neither of these substances had been isolated in a pure state and compared, it was impossible to prove their identity. There is now, however, a body of evidence which is in conflict with the theory that these two factors are identical, in spite of the fact that their distribution in nature appears to be so similar.

Pellagra.

Certain substances, which could cure or prevent polyneuritis in pigeons, failed to promote growth, and such was found to be the case with a very active fraction extracted from yeast (Kinnersley and Peters, 1925). Conversely, Goldberger and his co-workers (1926) found that autoclaved yeast (*i.e.* yeast heated to a certain temperature) failed to promote growth in rats or to prevent symptoms of paralysis which frequently ended in death. If, however, a small dose of an alcoholic extract of corn meal (to provide the anti-neuritic vitamin) was added to the diet, the animals grew normally. When the basal diet was supplemented with the anti-neuritic substance only, growth declined and the picture of pellagra (a disease prevalent in maize-eating countries such as the United States and



THE EFFECTS OF VITAMIN B—II.
The intestine of a rat fed on a diet deficient only in vitamin B, showing the great difference in the size and character of the tissues.

THE EFFECTS OF VITAMIN B—I.
The normal appearance, magnified 120 times, of the intestine of a rat fed on a diet rich in vitamin B. (The mucous membrane is shown above, and the two narrow bands below are the internal and external muscular coats.)

Italy) was exhibited by the animals. This condition was curable by the addition of autoclaved yeast to the diet. Goldberger considered the disorder to be the analogue of human pellagra, and that a vitamin deficiency lay at the root of the disease.

This substance he provisionally termed the pellagra-preventive or P-P factor. Although the complete story has not yet been told, it is obvious that Goldberger had thrown new light on this baffling disease, which up to the time of his experiments was thought to be due to the poor quality of the protein in the diet. His findings have led to the recognition of at least two water-soluble vitamins. Chick and Roscoe (1927), who confirmed Goldberger's conclusions, proposed to retain the term anti-neuritic vitamin for the anti-neuritic

substance originally discovered by Eijkman which prevents or cures polyneuritis in birds and paralysis in mammals. They further suggested that the term vitamin B should provisionally be confined to the second water-soluble vitamin which protects against pellagra (Goldberger's P-P factor).

Scurvy and Vitamin C.

Scurvy is also a disease of great antiquity, but unlike beri-beri it has for centuries been regarded as being caused by some deficiency in the food. It has played a part, and often an important one, in every big war, including the last, and the history of this terrible disease proves that it has been a subtle political factor. In many early writings are to be found clear ideas as to the etiology and cure of the disease, and this is particularly true of Dr. James Lind's celebrated *Treatise on the Scurvy*, published in 1755. Freeing himself from the dogmas and prejudices of his time, he gave a true picture of the cause, symptoms and cure of this disease. In the treatment of the disease he placed oranges and lemons first, next to these cider, and then dried vegetables in order of efficacy, while many other so-called remedies he proved to be worthless. Although Lind's work appears to have gone largely unrecognised, it probably formed the basis of Captain Cook's success in so wisely rationing his crews that scurvy was unknown. The history of scurvy onwards to the Great War only serves to show how often mankind fails to profit by past experience and to apply knowledge which might be the means of averting much human suffering.

A GUINEA-PIG WITH SCURVY
The "face-ache" position typical of this disease, which is caused by a deficiency of vitamin C.

Modern investigations on scurvy may be said to commence with the work of the Axel Holst school in Oslo. They made a thorough study of the etiology, symptoms, and methods of prevention and cure of scurvy produced experimentally in the guinea-pig. They were able to show that scurvy in the human and experimental scurvy in the guinea-pig were completely analogous. This important contribution made possible accurate and reliable experiments upon the anti-scorbutic value of all the staple foodstuffs we rely upon for life. Another result of great practical importance was obtained by Furst in Professor Holst's laboratory by the method just made available. He showed that whereas cereals and pulses are unable to prevent scurvy in the dry state, anti-scorbutic properties are developed when germination is started by soaking in water for two or three days. This knowledge was utilised by the troops in the Mesopotamian campaign, when they sprouted their lentils and beans to protect themselves from the disease.

It was soon realised that rats and mice, upon which vitamin research has been chiefly carried out, are able to flourish and rear healthy offspring on a synthetic basal diet to which only water-soluble B and fat-soluble A have been added. Upon a diet such as this man would contract scurvy, as would a monkey or a guinea-pig. But some rodents on similar diet do not appear to exhibit definite susceptibility to scurvy over long periods. Considerations such as these led to the recognition of a third accessory factor termed water-soluble C.

Fat-Soluble Vitamins.

For the next advance in our knowledge we are again indebted for the most part to American research workers. Up to this point investigators had concerned themselves principally with the idea that the physiological function of fat-soluble A was to promote growth. Five years after the discovery of fat-soluble A it had come to be realised that this vitamin was also necessary for the prevention of the

[From the Medical Research Council's Report on Experimental Rickets.

THE EFFECTS OF VITAMIN D—I.
A puppy which has developed rickets after a thirteen weeks' diet of oatmeal and olive oil. (From Professor Mellanby's experiments).

eye disease xerophthalmia. Just about the time this conclusion was receiving acceptance Mellanby published his work on the experimental production of rickets in puppies by diets deficient in the fat-soluble vitamin, and its cure by administration of cod-liver oil. As a result of this work, Mellanby formulated the theory that a deficiency of this vitamin was a cause of rickets and that the growth-promoting and anti-xerophthalmic effects were probably attributable to the same vitamin. Thus the so-called fat-soluble A now had thrust upon it a third responsibility, the prevention of rickets. The very different nature of these two diseases, xerophthalmia and rickets, might perhaps have suggested that their cure by means of cod-liver oil or butter was due to separate and distinct factors. As could be expected, a period of great confusion followed in which the voices of many different schools were heard. It is only possible to indicate briefly the chief of these, which may be summarised as follows :

(1) A conservative element maintained that rickets did not arise from errors in the food, but was essentially an infection. Exercise was considered beneficial.

(2) Mellanby, as stated above, considered the disease to be definitely of dietetic origin and induced by deficiency either of calcium or phosphorus, or the anti-rachitic vitamin. The latter was considered to be identical with fat-soluble A.

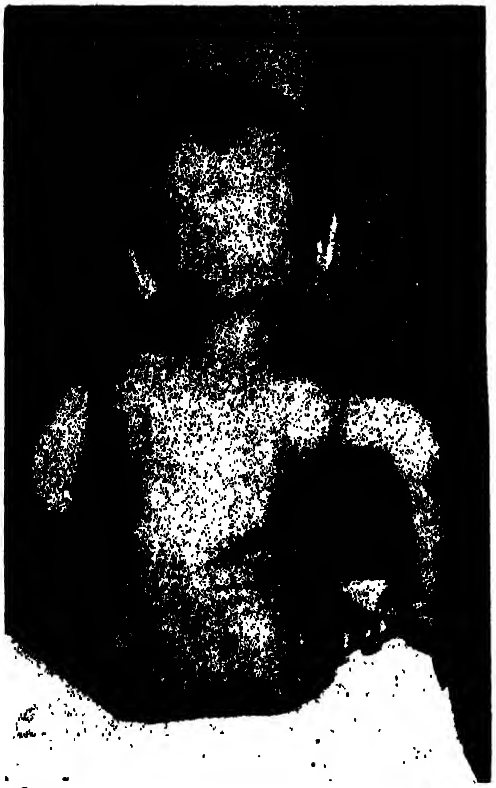
(3) The school of McCollum regarded the ratio of calcium to phosphorus as more important than the actual amounts of these elements in the diet. The importance of the anti-rachitic vitamin was recognised, and it was considered not to be identical with fat-soluble A.

(4) Hess and Unger in America and Huldchinsky in Germany showed that rickets could be cured by exposure of the subject to strong sunshine or ultra-violet radiations, thus confirming an earlier speculation by Palm in 1890.

The clinical and laboratory experiments of Harriette Chick and her colleagues studying post-war malnutrition in Vienna disposed

[Photos by permission of the Controller, H M Stationery Office

THE EFFECTS OF VITAMIN D—II.
A puppy from the same litter fed on the same diet with the addition of a very small daily portion of cod-liver oil—it has remained in good condition.



Courtesy] [British Hanovia Quartz Lamp Co.

ULTRA-VIOLET LIGHT AND VITAMIN D—I.

Severe curvature of the spine in a fresh case of rickets—a disease due to lack of vitamin D.

of the infection theory and at the same time confirmed the efficacy of sunlight and ultra-violet rays on the one hand, and cod-liver oil and butter on the other, in curing rickets.

McCollum, Simmonds and Becker now demonstrated, by the aeration of cod-liver oil at high temperatures, that the anti-xerophthalmic factor was much more readily destroyed than the anti-rachitic factor, thus disproving Mellanby's belief in their identity. The action of light in curing the disease remained an isolated but unexplained fact until some explanation of the phenomenon was provided by the work of Steenbock and his colleagues at Wisconsin. They showed that direct irradiation either of the animal or its food produced equally good anti-rachitic effects, and further, that these effects had been engendered in the oils and fats of the food. Many important recent discoveries in the elucidation of the nature of the vitamin have sprung from these observations, but it will be convenient to consider this extensive field at a later stage. In this way, fat-soluble A was shown to consist of two vitamins, one responsible for growth-promoting and anti-xerophthalmic effects (vitamin A), the other, responsible for anti-rachitic effects (vitamin D).

Fertility.

Still another fresh field in the question of fat-soluble vitamins was opened in 1922 by the work of Professor Evans and his school at Berkeley University, California. It had previously been observed in numerous experiments that animals restricted to a diet deficient in one of the then known vitamins suffered from a lowered reproductive capacity. Evans and Bishop showed that this condition of sterility in both male and female must be due to the absence of an unknown substance of the nature of a vitamin. Only when this third fat-soluble factor, vitamin E, was restored to the diet in the form of lettuce leaves, or notably of wheat germ oil, could normal reproduction

Courtesy] [British Hanovia Quartz Lamp Co.

ULTRA-VIOLET LIGHT AND VITAMIN D—II.

The same child after treatment by ultra-violet rays. The back is longer and the spine considerably straighter.

[Sport and General

A MEDIUM FOR OUR VITAMIN SUPPLY
If the milk of cows is to be rich in vitamins, the animals must have access to open pastures, especially when the grass is young, short, and growing.

be restored. Consequently, the conditions corresponding to deficiency of this factor, sterility and certain degenerative changes in the reproductive organs, in the rat must be regarded as being largely of dietetic origin. How far this conclusion applies to man is at present unknown, but it is obvious that these results are of great interest to the human race.

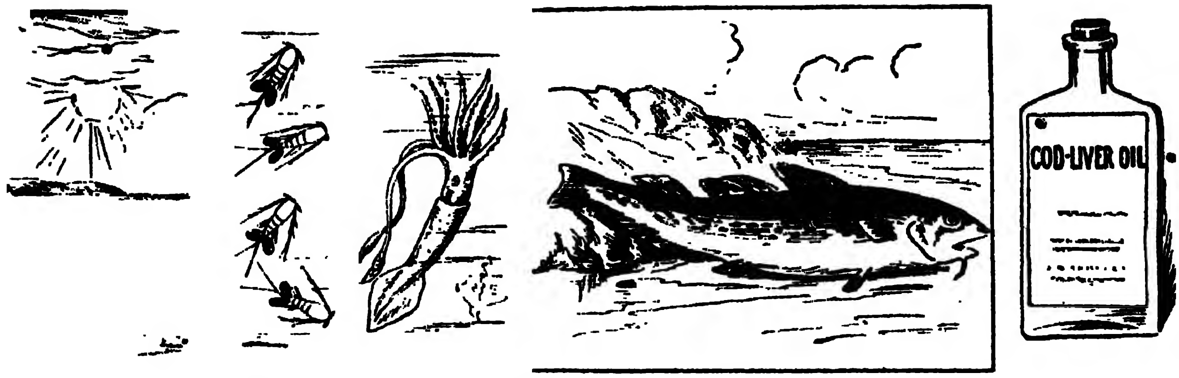
The incompleteness of our knowledge of the vitamins and the inevitable state of flux of a field of intensive research in which discoveries are being constantly made, call for a critical attitude of mind in reviewing the field. Thus it would seem very possible that this growing family of vitamins is even yet far from being defined. It may be discovered, for example, that McCollum's "water-soluble B" contains further substances of the nature of vitamins leading to the recognition of distinct factors. It may be that the anti-sterility vitamin E cannot adequately cover the needs of both male and female, and that their vitamin requirements in reproduction may consequently be different. Even in the function of lactation, the recent results of Barnet Sure in America are suggestive and might be interpreted as foreshadowing the possible existence of yet another accessory food factor.

VITAMIN A

Cod-liver oil is the richest known source of vitamin A, and incidentally of vitamin D also, and it is to the combination of these two factors that the unique medicinal value of the oil is due. If one were to attempt an answer to the question as to why cod-liver oil should be so potent a source, one can learn something about the origin and nature of this important vitamin.

Origin.

As a result of much patient work, the origin of vitamin A can be traced back through a series of fishes to the vegetable kingdom. The chain of events works out in Nature somewhat along the following lines. Normally, the cod feeds upon smaller fish such as salps and squids, which in turn live upon small marine animals known to zoologists as copepods, amphipods, larval decapods, mollusca, etc. These again eat the diatoms—



THE ORIGIN OF VITAMIN A—"BOTTLED SUNLIGHT"

Minute plants floating near the surface of the ocean produce vitamins A and D under the influence of the spring sunlight. The plants are eaten by copepods and other tiny creatures and the vitamins pass, via squids and small fish, into the liver of the cod.

very minute plants floating about in the uppermost layer of the ocean and known as marine algæ. The vitamin itself is produced by these minute marine plants during the sudden outburst of light and growth which occurs in the spring. It has been shown, moreover, that one of these diatoms (Nitzschia closterium) is capable of synthetising the vitamin in the laboratory when grown in sterilised sea-water in the light, and that the amount of vitamin A thus produced is high.

With farm animals, which are amongst the chief producers of human food, a picture almost parallel may be drawn. Dairy cows on pasture consume direct large amounts of vitamin A along with other accessory factors, in grazing ; and recent work has shown that this is particularly true when the grass is young, short, and growing. The cow thus obtains from the forage grasses and clovers ample supplies of both fat-soluble and water-soluble vitamins to meet its own individual needs, to enrich its milk, and when occasion arises, to provide extra supplies for the unborn animal during the period of gestation. The importance of this last consideration is of the greatest significance, for it holds equally true in the case of the human mother.

Milk and its Products.

On the other hand, the milk of cows fed in shippons on cakes and cereals with no access to the meadows, is deficient in vitamins. Chick and Luce in this country have shown that when the food of stall-fed cows receiving a ration of cereals and roots is changed to young green grass and clover, there is as much as a five to tenfold increase in the vitamin A content of the milk. Once again it is seen that the animal's well-being, and in the same way man's, is determined by the character of the food eaten.

What has been said in regard to milk applies *a fortiori* to all the products derived from it, *i.e.* cream, butter and cheese ; because these important products of the dairy industry likewise derive whatever vitamins they may contain from the original cow's milk. Fresh summer cow's milk should contain considerable amounts of vitamin A, while dried milk, sterilised, boiled, pasteurised, and condensed milk should all contain a considerable amount of this vitamin. In human milk it is present also, though varying in amount. It is noteworthy that in milk the whole of the vitamin A content is not located in the fat globules, but that approximately one-half of the total is present in the whey. Vitamin A is also found in small amount in buttermilk. Fresh dairy butter is a rich source of the vitamin, though here again the amount present tends to vary considerably amongst different samples, and with the season of the year.

Margarine, prepared either from vegetable oils or from lard, does not contain this vitamin ; but margarine prepared from animal fats other than lard may contain it (oleomargarine), the amount depending, of course, upon the quality and percentage of

the animal fat present. It may be mentioned here that, since the close of the war, efforts have not been spared to devise a method of replacing the fat-soluble vitamins A and D, which may either have been absent originally or have been destroyed during the refining process. It would appear that these efforts have now succeeded on the industrial scale. It is not suggested or recommended that margarine (even though vitaminised) should take the place of dairy butter; but where economic circumstances are a first consideration, butter unfortunately is frequently excluded from the worker's dietary. In this case, it is to be preferred that a margarine with vitamins artificially superadded should be used in preference to a product devoid of these essential factors.

Animal Sources.

The animal kingdom furnishes the richest sources of vitamin A, the liver of most animals, birds and fish acting as a storehouse for reserve supplies. The yolk of eggs is also very rich in this factor. The liver oils of such fish as the cod, haddock, tuna-fish, herring, sardine, eel, and the shark have been principally used for human needs.

In the case of mammals, the fat of the heart and kidneys and especially the liver oil of the ox and the sheep, though again subject to variation with the diet of the animal, are potent sources of vitamin A. The value of lard from this point of view is of considerable practical importance to the housewife, to say nothing of the consumer. The vitamin A content of lard may vary from its total absence to its presence in appreciable amount. Because of this extreme variation and the fact that the vitamin A (if any) may be partially destroyed in refining, lard should not be relied upon to supply this factor.

Plant Sources.

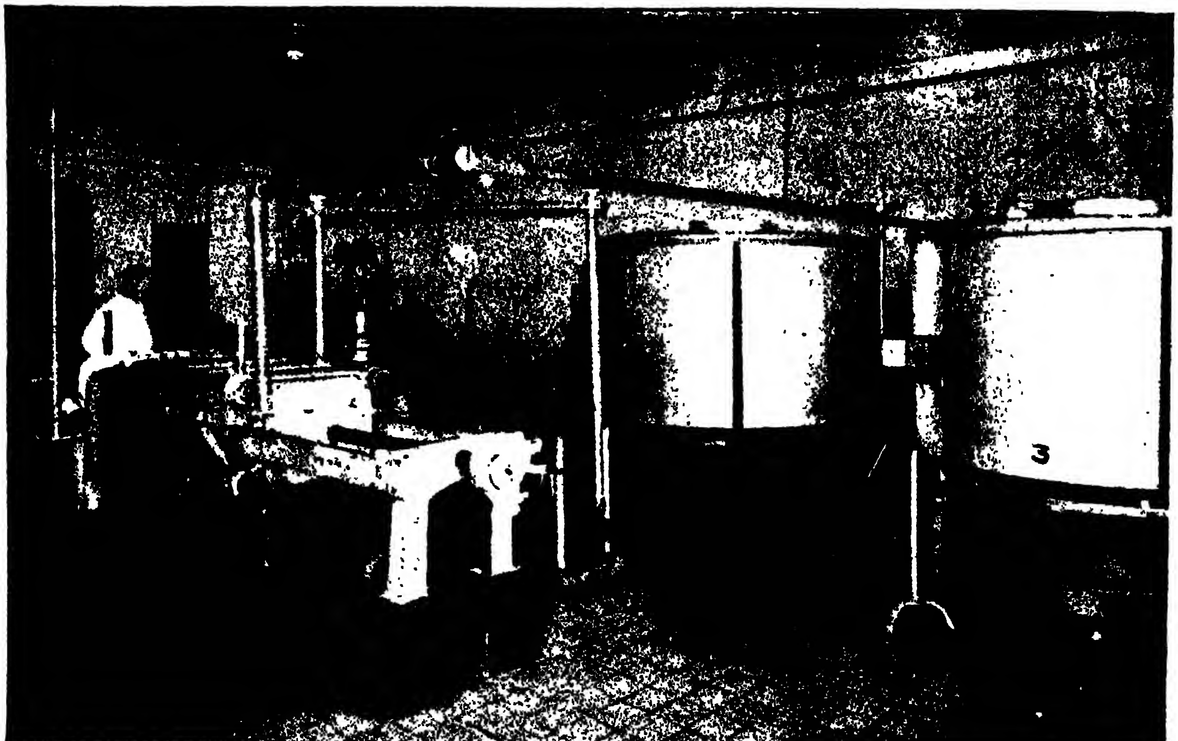
For the most part, the plant kingdom presents a remarkable contrast, for there appears to be no good economic source of vitamin A available amongst the vegetable oils. Olive oil, cotton-seed oil, palm-kernel oil, soya-bean oil, groundnut oil, coco-nut oil, corn oil, and the nut oils (*e.g.* almond, brazil, walnut) contain only small amounts or even none at all. Perhaps with the exception of the orange (which incidentally contains still more of this vitamin in the rind) and the tomato, the fruits generally do not contain this accessory factor. But it is somewhat curious to find the vitamin occurring abundantly where there is little or no oil or fat. Thus we find young green vegetables such as lettuce, spinach, cabbage, sprouts, watercress, and green peas are all rich sources. The plant is able to synthesise the vitamin in the laboratory of its green leaf, but man and the animals are entirely dependent on the plant world for their supplies. Vitamin A is frequently found associated with certain plant pigments known as carotin, xanthophyll and lycopin; and it was at one time thought that the vitamin might be identical with one or other of these natural colouring matters. Investigation, however, has shown this idea to be improbable.

While we know that the plant can manufacture much larger amounts of vitamin A in the light, it is not certain that light is essential for its synthesis. This rather unsuspected discovery opens up the practical possibility that by germinating seeds for some days, the vitamin A content is thereby increased. Of the rôle of the vitamin in the nutrition of the plant and of the animal, we know practically nothing. However, several fundamental facts have emerged as a result of much research. We know that in man and the lower animals this vitamin can be stored up principally in the liver and in the fatty tissues surrounding the vital organs. We know also that the requirement of different animals for this vitamin varies considerably, the pig, for example, requiring less than the rat, while the rabbit requires more. Lastly, we know that an adequate amount of this vitamin is even more urgent and indispensable to the young growing child or animal than it is to the adult. Although our knowledge of the functions of vitamin A is thus admittedly very meagre, the facts so far established by experiment are of the first significance when applied to the clinical problems of maternity and infant welfare.

Vitamin A is of fairly stable nature, being susceptible, however, to oxidation; the susceptibility increasing markedly as the temperature rises. For example, if air is bubbled through cod-liver oil heated to the temperature of boiling water, the vitamin A is completely destroyed within an hour and a half. Moreover, it has been shown that vitamin A suffers destruction when exposed to the ultra-violet rays that create the anti-rachitic vitamin D (*q.v.*). Destruction follows in the case of vitamin A whether the material is exposed to the radiations of the quartz mercury vapour lamp or to the ultra-violet rays present in strong sunshine. These facts serve to differentiate vitamin A from vitamin D. Possibly a recent discovery of still more significance is the fact that when once the destructive process has been initiated, the remaining vitamin A appears to have been rendered unstable so that eventually it completely disappears These findings of the laboratory are obviously of immediate interest not only to commerce but also to the intelligent layman. Thus ordinarily in cod-liver oil the oil itself, in some way not yet understood, acts to some extent as a preservative. However, when cod-liver oil is exposed for sale in white bottles, frequently with a volume of air in the unfilled portion of the receptacle, and exposed to light, we now know that we have present most of the conditions conducive to the destruction of vitamin A. Cod-liver oil, therefore, should be marketed in well-corked non-actinic amber bottles, and stored in a cool dark place.

Vitamin A Deficiency.

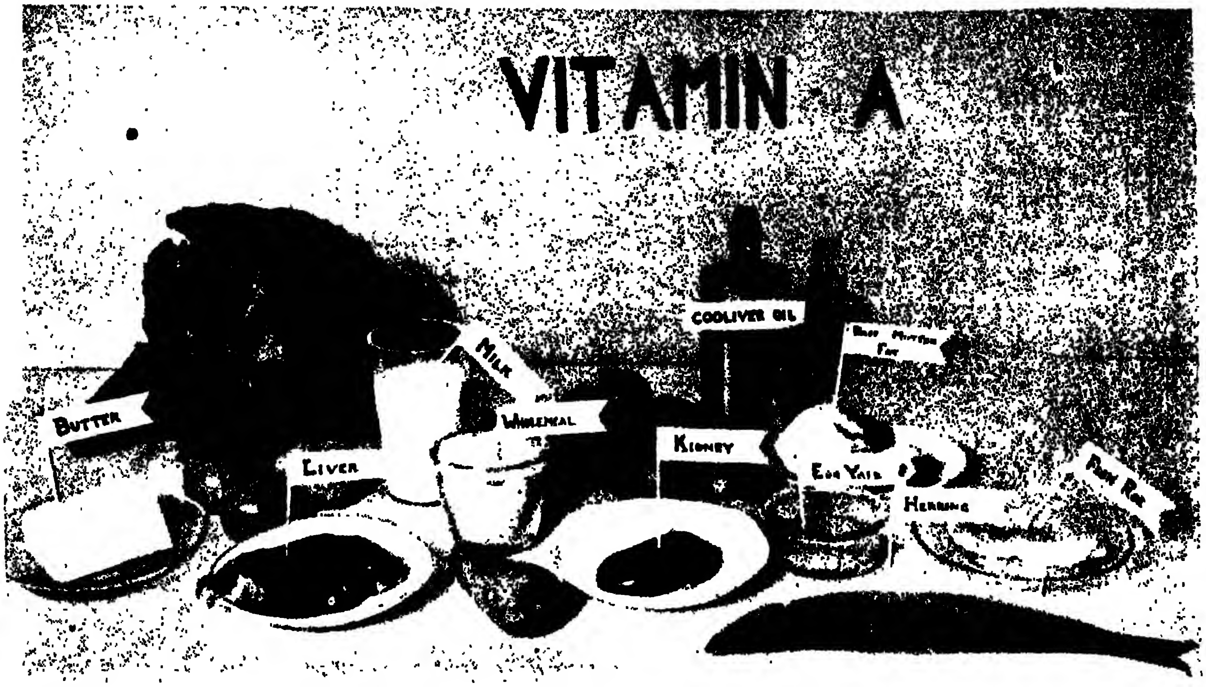
We have still to consider briefly the effects of a severe deficiency of vitamin A. In rats, as we have seen earlier, absence of this vitamin leads eventually to a catarrhal condition of the mucous membranes which, in the case of the eye, is specially characteristic. Here the corneal tissue becomes inflamed and ulcerated, and eventually total blindness supervenes. At the same time, growth is brought to a standstill or is even declining. The



Courtesy] [A. P. V. Co., Ltd.

HOW MILK IS PASTEURISED

A pasteurising plant in a Dutch factory—a method by which the bacterial content of milk is considerably reduced without materially affecting the vitamins.



Courtesy] [*"Good Housekeeping"*]

FOODS RICH IN VITAMIN A

Man obtains his chief supplies of this vitamin from the animal kingdom, though certain young, green vegetables are rich sources.

actual inflammatory condition can be caused apparently by any bacteria that may at that time be present in the eye; but the phenomenon affords a classical example of the serious lowering of the bodily resistance against bacterial infection as a direct result of vitamin A deficiency.

Under the disability of this same vitamin deficiency, an identical picture is produced in infants, in this case the disorder usually being known as keratomalacia, and sometimes as hikan in the Far East. But the trouble at bottom has been shown to be the same. During the war, two Danish physicians, Bloch and Ronne, treated almost a hundred cases of this disorder amongst the infants of Copenhagen. The disorder yielded promptly to administration of cod-liver oil and fresh milk when the ordinary ophthalmic treatment had failed.

A condition similar to keratomalacia in children, known as "night-blindness," is exhibited by adults when the diet is seriously deficient in vitamin A. The condition is common in certain parts of the rice-eating countries of the East, but is also encountered regularly in Russia at the season of fasts imposed by religious observance.

Although the general lowering of the bodily resistance against disease is perhaps the most serious effect of this deficiency, there are other symptoms which, in the light of fuller knowledge, may eventually be attributable to the absence of vitamin A. Disorders of the respiratory tract, colds, intestinal infections, and even the poor condition of the hair of experimental animals can be regarded as the effects of deficiency of vitamin A.

During the last decade persistent attempts have been made to isolate this vitamin in a pure state. Chief amongst these endeavours is the work of the Drummond school in this country, of the late Major Takahashi in Japan, and of Dubin and Funk in America. All these investigators have succeeded, by many tedious and time-consuming operations in the laboratory, in preparing extremely potent fractions of vitamin A from the unsaponifiable matter of cod-liver oil. Moreover, Takahashi also succeeded for the first

Isolating the Vitamin.

time in obtaining a similar highly active fraction from a vegetable source (spinach). The chemical examination of these active fractions showed that they were yellow or reddish-yellow oils, that they possessed the odour of terpenes (the principal constituents of essential oils), and that they belonged to a class of compounds known to the chemist as unsaturated alcohols. Furthermore, analysis indicated that the fat-soluble vitamin molecules are built up of carbon, hydrogen and oxygen only.

The fraction prepared by Drummond and tested in 1925 was found to be so active that the infinitesimal dose of one hundred-thousandth part of a gram per day for a rat of 100 grams body weight, *i.e.* representing 0.0006 per cent. of the animal's total food consumption, was sufficient to maintain its health and to protect it from the effects of vitamin A deficiency! However, in spite of all this careful work and the minuteness of the effective dose, the most that Drummond could claim was that the fraction thus obtained, though possibly the most potent concentration of vitamin A yet prepared, was still far from being pure vitamin.

Colour Tests.

In order to test any product for the presence of vitamin A, it is necessary to carry out a biological assay on the rat, and to do this at least three months are required. Unfortunately at present this is the only certain method. But its usefulness is limited by the fact that not only is it tedious and time-consuming but also that a very wide margin of error is unavoidable. Considerations such as these have encouraged scientists to devise possible chemical tests for the vitamin which could be carried out in a few minutes. This work has resulted in the discovery of at least two re-agents, arsenic trichloride and antimony trichloride, which produce a beautiful blue colour when mixed with cod-liver oil or other oils containing the vitamin.

Although it is yet too early to say quite definitely whether it is actually the active vitamin A which is being so readily determined in this way, evidence in favour of this view is gradually accumulating. For example, using the antimony trichloride re-agent discovered by Carr and Price, which is the safer and more satisfactory of the two, the test has already been applied to many staple food products other than fish liver oils.

Amongst these, butter, margarine, suet, lard, dried milks, egg yolk, spinach extract, orange juice, etc., have been examined and so far the results obtained are in accordance with the findings of animal experiments (Willimott and Wokes). When the specificity of such chemical tests has been fully established, much more rapid progress can confidently be expected in our knowledge of the part played by this vitamin in the work of the body, and of its distribution in the staple foods upon which we rely for life.

VITAMIN B

By ETHEL BROWNING, M.D., Ch.B., Formerly House Surgeon at the Stanley Hospital, and Assistant School Medical Officer, Liverpool.

UNTIL very recently it was believed that vitamin B was almost exclusively connected with the disease known as beri-beri, a condition rarely found in European countries, and that therefore the amount of vitamin B in the diet was comparatively unimportant so long as enough was present to prevent the development of beri-beri. But among the most definite results of vitamin research since 1927 has been the discovery that the substance originally known as vitamin B consists of at least two parts (the latest investigations foreshadow a third), one concerned with the development of beri-beri, called the anti-neuritic, or vitamin B1, and the other, concerned with growth and also with the prevention of the disease known as pellagra, called the anti-pellagric, or vitamin B2.

Beri-beri.

Beri-beri is a disease which, in human beings, is characterised by severe neuritis, causing paralysis and loss of sensation, and also by a disturbance of the heart, and sometimes widespread dropsy. In birds, which are often used for

testing the effects of vitamin B deficiency, a condition occurs, believed to be the equivalent of human beri-beri, which is called avian polyneuritis. The nervous symptoms are very prominent in birds, and appear sooner than in other animals or human beings. After fifteen to twenty days on a diet without vitamin B, the legs and wings quickly become completely paralysed, and unless vitamin B is given, death follows in less than forty-eight hours. If, however, vitamin B is administered, the birds recover with surprising rapidity, the power to walk and fly returning within a few hours.

Pellagra also is a disease not commonly seen among races who live on a varied diet.

Pellagra.

Since it chiefly occurs among people whose staple diet is maize, it was at one time believed to be due to some poison associated with maize. Its principal symptoms are digestive disturbances, associated with a peculiar appearance of the tongue, and a characteristic skin eruption. In young animals a diet which is deficient in vitamin B2 produces severe skin lesions, with wasting and weakness and complete lack of growth, and these symptoms can be cured by giving foods known to be rich in the growth-promoting, anti-pellagric vitamin.

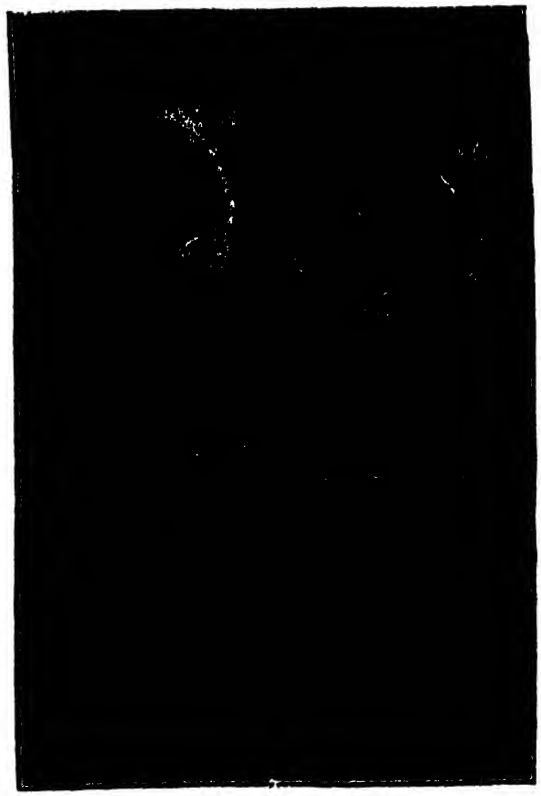
Besides these two definite diseases, lack of vitamin B1 and B2 gives rise to many other disturbances of health. Loss of appetite is so marked that many workers have found it difficult to decide whether the rapid loss of weight which occurs in animals whose diet is deficient in vitamin B is due entirely to the vitamin deficiency or to partial starvation, because the animals refuse to eat the food offered to them.

The body temperature has been found consistently below normal in vitamin B deficient animals, and with the lowered temperature goes a tendency to be susceptible to infection by many diseases, a condition which has also been found in children in countries where the diet is noticeably lacking in vitamin B.

Congestion and even hæmorrhage of the bone-marrow, followed by degeneration, have been reported by some workers in vitamin B deficiency, and yet others have stated that the wall of the intestine becomes weakened, so that constipation results.

In deprivation of vitamin A, the adult animal or human being is not nearly so susceptible as the young, growing organism, because the body tissues are able to store vitamin A for use in an emergency. This is not so in the case of vitamin B, at any rate in that portion of it known as vitamin B1. The adult is just as susceptible to deficiency of vitamin B, and develops the symptoms of beri-beri just as rapidly, as the young animal, because the tissues are apparently unable to store vitamin B.

It has already been remarked that the original "water-soluble" vitamin B, so called because it was first found, not in association with fats, as in the case o vitamins A, D, and E, but in the watery

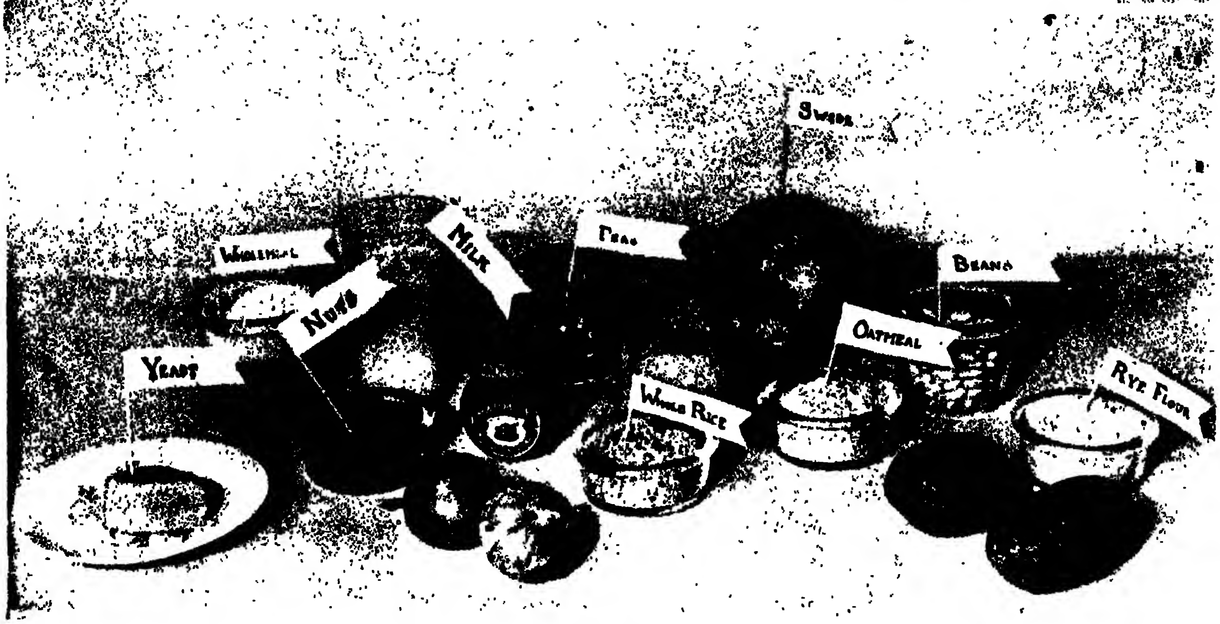


Courtesy] [*"Diseases of the Skin," J. H. Sequeira*
(*J. & A. Churchill*)

A TYPICAL CASE OF PELLAGRA

A child showing the skin eruption on the hands and face characterising this vitamin deficiency disease.

VITAMIN B

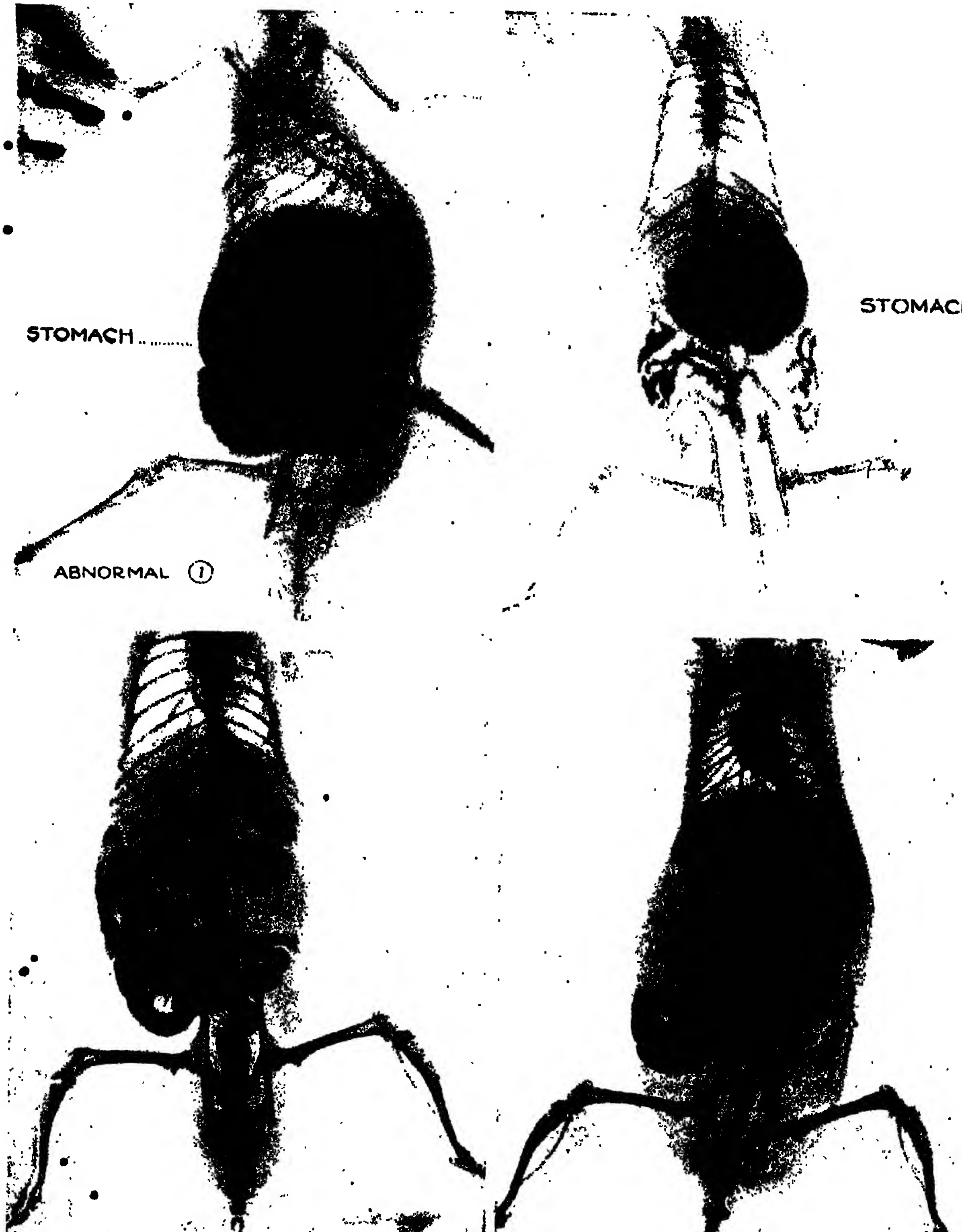


THE CHIEF SOURCES OF VITAMIN B

extracts of grains and cereals, is now considered to consist of two, or even three, parts. These parts all occur more or less in the same foodstuffs, but the proof of their separate existence rests chiefly on the fact that foods which contain all of them are richer in one than the other. For example, wheat and maize are richer in the anti-neuritic than the anti-pellagric vitamin, while bananas are at least three times as rich in the anti-pellagric as the anti-neuritic. Many yeasts also differ in the relative amounts of each they contain, some which are capable of maintaining growth and preventing pellagra being quite incapable of preventing polyneuritis. The liability of the different parts to be destroyed by varying degrees of heat, their differing solubilities in certain substances such as alcohol and acetone, and other chemical and physical properties, have also helped to distinguish them. In attempting to isolate vitamin B from the foods in which it is contained, a method has been employed in which Fuller's earth is used to extract or "absorb" the vitamin. It has been found that more of the anti-pellagric vitamin is absorbed by this method than the anti-neuritic. On the other hand, if yeast is heated in an autoclave, all the anti-neuritic vitamin B1 is destroyed while the anti-pellagric B2 remains untouched. The suggestion of the third vitamin B has arisen out of this latter discovery. If pigeons which are suffering from the symptoms of vitamin B deficiency are given yeast which has undergone both these processes (absorption by Fuller's earth and autoclaving), they do not respond by any improvement in their condition, but if given air-dried yeast they do, suggesting that the substance which cures them must be something present originally in yeast and sensitive to destruction by heat.

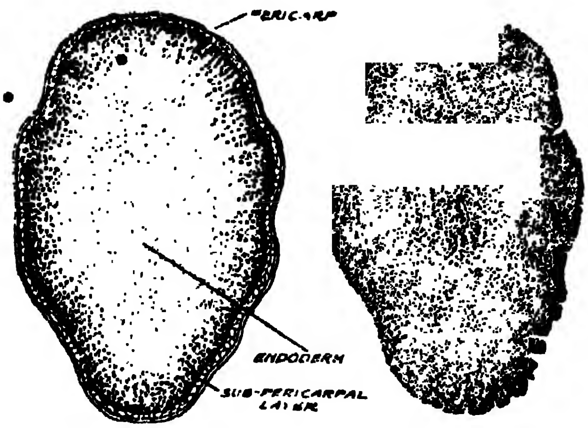
Distribution in Nature.

Vitamin B is very widely distributed in Nature ; the plant world is alone able to manufacture it, when it is found in animal tissues it has made its way there from a plant source. The three chief sources from which vitamin B is derived for human consumption are the seeds of grains and cereals, eggs, and yeast, but milk, some fruits and vegetables, and



EFFECTS OF VITAMIN B DEFICIENCY ON RATS

One of the many ill effects of a diet deficient in vitamin B is the degeneration of the digestive tissues causing severe constipation. These X-ray photographs taken after bismuth meals show (1) great distension and dropping of the stomach after a twelve-weeks' diet of white bread deficient in vitamin B; (2) a normal animal of the same age with wheat embryo added to the same diet; (3) without vitamin B—the opaque diet has not been expelled after forty-eight hours; (4) with vitamin B—the bismuth meal has all been expelled.



THE EFFECT OF POLISHING RICE

A section through grains of rice, much enlarged, showing *left*—a whole grain; *right*—a polished grain with almost all the outer part, which contains vitamin B, removed.

nuts also contain it. In cereals such as wheat and rice the vitamin is found chiefly in the parts which are removed by modern manufacturing processes, milling in the case of wheat, and polishing in the case of rice. On this account wholemeal flour and unpolished rice should be used to ensure the presence of vitamin B. In eggs, light boiling does not destroy the vitamin, but frying probably does. Yeast is not used as a food in itself, but in the form of extracts added to soups, etc., it provides vitamin B in a concentrated and palatable form.

Certain fruits, such as bananas, tomatoes and the avocado pear, contain vitamin B, while in vegetables it is present especially in turnips, celery, asparagus, potatoes, cabbage, lettuce and watercress.

Cows' milk contains a good deal of vitamin B; unlike vitamins A and D, vitamin B appears to be present in milk even when the cows' diet is deficient in it. This is because vitamin B can be manufactured by the action of bacteria, which, in the ruminant stomach of the cow have the ideal conditions provided for their beneficial action. In the human being, however, these conditions are absent, and therefore the mother's milk depends for its vitamin B content upon the amount present in her diet. It has been proved that a mother requires more vitamin B during the period of lactation than at any other time. She must therefore take special precautions to see that her diet, both during pregnancy and the nursing period, contains articles such as wholemeal bread, eggs, milk, fruit and vegetables, if she is to provide a sufficient amount for the child's welfare in the earliest and most important part of its existence.

VITAMIN C

By S. G. WILLIMOTT, Ph.D., B.Sc., A.I.C., Government Analyst and Lecturer in Chemistry to the Government of Cyprus.

Vitamin C is sharply distinguished both in origin and character from its water-soluble partner, vitamin B. Orange juice and lemon juice are the richest known sources of this vitamin, and their constancy as such has led to their use as the standard of comparison for all anti-scorbutic (anti-scurvy) substances. It is somewhat surprising to find that the lime, another member of the citrus family, is distinctly inferior as an anti-scorbutic. Preserved lime juice has now been replaced in navies and expeditions by lemon juice, and even this appears to be making way for orange juice in a concentrated form. Grapefruit, the remaining member of the family, is only less rich in vitamin C than the orange or lemon. The tomato (raw or canned), young cabbage and swede juice are other excellent sources of the vitamin. Fruits, such as the apple, pear, banana, grape, and the English berries as a class, are all indifferent sources. High protein foods such as eggs, meat, and fish are, as a class, poor sources of this vitamin. Milk is an indifferent source of the anti-scorbutic substance, and, moreover, its content has been shown to vary with the food of the cow and the season. Cow's milk cannot be relied upon to supply this factor in the diet, especially in the case of infants and growing children.

Sources.

Amongst root vegetables there are strange differences. Although the swede is rich in vitamin C, the carrot and beet contain little, while the raw potato is intermediate in value, but after boiling or baking its value is greatly decreased. It is perhaps noteworthy that both the cabbage and the swede are members

of the natural order of cruciferæ, *i.e.* plants with a cruciform arrangement of the flower. Such plants, according to an old legend, were of special value to the human race, a teaching not out of harmony with the results of modern research.

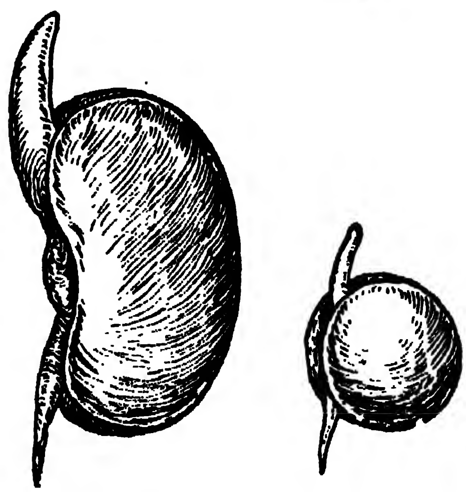
Wherever vital processes are active, there the anti-scorbutic vitamin is to be found. Thus it occurs abundantly in young green leaves and forage grasses, but is absent usually from dried fruits, dried vegetables, and seeds. Vitamin B, as we have seen, is associated with resting tissues, such as seeds; vitamin C, in contradistinction, is present where the vital processes are most intensive. Perhaps the best example of this distinction is to be found in the discovery that germination of the seed (devoid of vitamin C), in some way still unknown, generates the anti-scorbutic substance in the embryo plant. This simple discovery was destined to acquire historic fame and political importance; for as a result of extensive feeding experiments at the Lister Institute, London, Chick and Hume concluded that germination was the best practical method of providing vitamin C in military operations. Accordingly, the Indian troops in Mesopotamia during the war, who were suffering severely from scurvy, were advised simply to sprout their pulse in order to be protected. Peas, beans and lentils form a large proportion of the Indian diet, they can be transported to any distance, and they keep well. All these advantages rendered this simple method one of immediate practical utility to the armies in the field.

Complete deficiency of vitamin C is the cause of scurvy in man, a disease much more widespread a century or two ago than to-day. It was not merely a disease of the sea, being very prevalent in this country, in the northern counties. There are, however, important differences in susceptibility to the disease between man and the lower animals. The rat, mouse, and rabbit can apparently thrive on a diet which contains no vitamin C; whereas man, the ape, monkey, and guinea-pig are highly susceptible to its absence. Indeed the latter has been found to react to this deficiency in such a highly characteristic manner that it is almost always employed as the test animal for assaying the anti-scorbutic value of a given foodstuff.

Scurvy.

Vitamin C, the least stable of the vitamins, is characterised by its extreme sensitivity to oxidation, especially when heat is applied and when the conditions are changed from acid to alkaline. The practical application of this fact teaches that the too common practice of adding sodium carbonate to the water in which green vegetables are boiled, thereby destroying the anti-scorbutic factor, should be abandoned. The loss of vitamin C in different natural products, when exposed to heat, varies very greatly. Orange juice, for example, can be heated up to the temperature of boiling water for an hour without apparent loss of vitamin C, but cabbage juice under similar treatment, loses almost all. The commercial process of canning vegetables also leads to a considerable amount of destruction of this vitamin in the case of cabbage and runner beans, whereas tomatoes are little affected.

But in the complete absence of oxygen, Zilva proved that vitamin C is stable and can be exposed to heat and alkaline conditions without loss. This result, which is of considerable economic importance, has defined the necessary conditions for the



THE PRODUCTION OF VITAMIN C
Germination of seeds such as beans and peas produces vitamin C, where before it was absent—an important factor in the prevention of scurvy.

VITAMIN - C

THE CHIEF SOURCES OF VITAMIN C

Vitamin C, the absence of which produces scurvy, is most abundant in orange and lemon juice. It is usually present in growing plants, though the root vegetables vary greatly in their vitamin content.

preservation of vitamin C, *i.e.* absence of oxygen, acidity, and low temperatures. It was natural that many attempts should be made to translate these findings of the laboratory into large-scale operations in works. Perhaps the most successful of these attempts has been accomplished in California, where fresh orange juice is concentrated *in vacuo* to a thick orange-coloured syrup. By this method, the anti-scorbutic potency of orange juice is preserved, apparently over long periods, by the fruit sugars naturally present. Such a product, when standardised and reliable, is of great value in navies, on board ship, in expeditions, child welfare clinics, and to the manufacturer of fruit drinks and foods.

Vitamin C is readily soluble in water and in all strengths of alcohol. It does not appear to be removed from neutral solution by absorbents such as Fuller's earth, a behaviour the reverse of that of vitamin B. All mammals are dependent on the plant world for their supplies of this vitamin ; and moreover, the animal body does not store this factor, as in the case of vitamin A, so that regular supplies of it are essential. Zilva has succeeded in preparing from lemon juice a highly active fraction containing the anti-scorbutic substance. Although admittedly still impure, it has been shown that a minute dose of this concentrate (0.00015 gram per 100 grams body weight) was sufficient to protect a guinea-pig from scurvy.

The symptoms of complete absence of vitamin C, the tenderness and swelling of joints and changes in the structure of the bones, are well known in man and certain animals. The symptoms of deficiency are more subtle though equally important, and may manifest themselves in an unhealthy condition of the skin, or muddy complexion, and in degenerative changes in the structure of the teeth. The fact of this latter complication is not generally appreciated, but it is deserving of careful consideration in the task of preserving individual and national health.

VITAMIN D

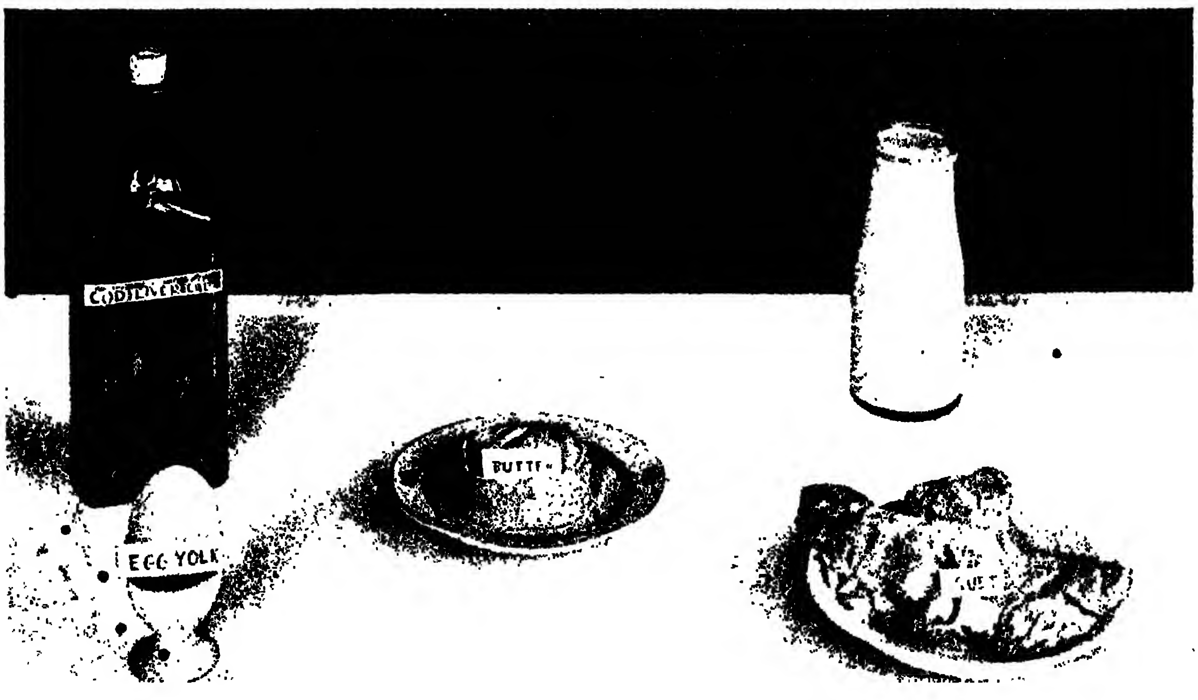
Vitamin D, the anti-rachitic factor, is of special importance in infant life. Its absence

from the food is the principal cause of rickets, one of the most widespread of infant diseases and one of the most serious in its effects in after-life. Vitamin D is also of peculiar interest to layman and scientist alike because it is at present the only known vitamin which can be produced by artificial means. It is therefore not surprising that this important dietary factor should have claimed a large share of public and professional attention.

Rickets.

Rickets is by no means a modern disease, nor is it confined to man alone. Historical research shows that it has long afflicted the human race. Two thousand years ago, Soranus stated that the majority of Roman children suffered from deformity of the spine and crooked legs, and observed that the disease was more prevalent in the city of Rome than elsewhere. Moreover, this writer attributed the absence of rickets from Greek children to the superior interest and care of the Greek mother to that of the Roman mother. Amongst the ancient Egyptians there appears to be no evidence of rickety conditions. In modern times the incidence of the disease and of its after effects is sufficiently disturbing. Thus Findlay, who made a special study of rickets in Scotland, wrote in 1918: "In this, as in most civilised countries, rickets is one of the most common diseases of childhood. Further, it is probably the most potent factor in interfering with the efficiency of the race. It not only stunts the growth and causes deformities, some of which greatly increase the dangers of child-bearing in the female, but it raises considerably the mortality rate of such diseases as measles and whooping cough, and is responsible for the rejection annually of a not inconsiderable number of army recruits."

In spite of many recent discoveries, the incidence of rickets is still quite serious, although the position is steadily improving as the following statistics show. Lawson Dick reported in 1916 that 80 per cent. of the children in the London County Council schools had suffered from rickets. A more recent report by Dr. Corry Mann in 1922 suggests that the position is improving, and prophesies that, with present progress, within a decade rickets should be rare in London.



FOODS RICH IN VITAMIN D

Cod-liver oil, beef suet, egg yolk, milk and butter in summer time—the richest known sources of vitamin D, which contain vitamin A also.

Courtesy] [British Hanovia Quartz Lamp Co.

TYPICAL SIGNS OF RICKETS

A photograph taken by chance in a public playground, showing bow legs and bulging foreheads—the most obvious effects of vitamin D deficiency in children.

Meanwhile, Sir George Newman's official report for 1927 reveals the fact that, of the children examined from all parts of the country, the number exhibiting signs of rickets had dropped to 50 per cent.

Rickets occurs for the most part in the temperate zone of the northern hemisphere, and is a scourge in most parts of Europe except in the countries bordering on the Mediterranean Sea. Many have believed rickets to be a necessary concomitant of Western civilisation. Certainly the disease is far commoner in the city than in the country. Rickets is comparatively rare in most parts of the tropics and sub-tropics and amongst the peoples of the Far East. As will appear later, it is significant that it is rarely found in the Far Hebrides or in Iceland.

Although the most obvious effects of a deficiency of vitamin D are seen in bow legs and a bulging forehead, rickets is by no means entirely a disease of the bones. The whole body is affected, and recent research seems to point to the intestines as being the seat of the trouble. The muscles are flabby, the abdomen protrudes, and the digestion is frequently disturbed and the nervous system disordered. The vitality is reduced and the infant is liable to contract infectious and pulmonary disease. Lack of vitamin D also results in defective tooth formation in children and adults and aids in the widespread dental decay of civilisation. Evidence is also accumulating that the formation of the so-called "stone" in the bladder is caused by deficiency of vitamin D in the blood. It is well known that most rickets-producing diets are characterised by an excess of carbohydrates. Mellanby believes the harmful influence of carbohydrates is due to the presence of certain poisonous bodies which he calls "anti-vitamins." Oatmeal was considered to be particularly rich in this anti-vitamin, but the harmful effect of the anti-vitamin could apparently be neutralised by vitamin D. How far these very speculative suggestions are justified will only be decided by further investigation.

Bone Formation.

The influence of the anti-rachitic vitamin in controlling the building up of calcium and phosphates into bones and teeth has long been realised, but the exact manner in which this rôle is carried out is still uncertain. We know that the absorption of calcium and phosphates is defective without vitamin D, and is increased by its administration. It also appears that the anti-rachitic vitamin is able to correct the improper ratio of calcium and phosphates in the food ingested. The greater the disproportion of this ratio the more vitamin appears to be needed. The presence of vitamin D in the intestinal canal renders the gut permeable to calcium and phosphates. Recent work both in England and America shows that in the absence of vitamin D, the portions of the canal which normally absorb minerals become alkaline, so that the calcium and phosphates cannot pass through the intestinal walls into the blood stream. On administration of the anti-rachitic factor, these areas once more become acid and permeable to the mineral salts (Bergheim; Redman, Willimott and Wokes.) Although these results throw new light on this obscure problem, further investigation is necessary for its solution.

We have already seen how the anti-rachitic vitamin D came to be regarded as a separate and distinct factor from the anti-xerophthalmic vitamin A. This differentiation became possible largely through the work of McCollum and his co-workers on cod-liver oil, and of Mellanby and others on the distribution of the anti-rachitic factor in vegetable oils and green vegetables. Also the discoveries in England, America, and Germany, which led the "dietetic" and the "sunlight" schools to a satisfactory reconciliation, have been outlined previously. Little therefore need be said here on these important topics.

Distribution in Nature.

Relatively little is known regarding the distribution of the anti-rachitic factor in nature, but it appears to bear some general similarities to that of vitamin A. Thus the richest known sources of both vitamin D and vitamin A are found in the liver oils and fats of the cod and other fish, and of certain animals and birds. Appreciable amounts of vitamin D (and also of vitamin A) are found in animal fats, summer milk and butter, beef suet, and egg yolk. As we shall see later, irradiated ergosterol has recently been found to be the richest artificial source.

When plant sources are examined discrepancies in this parallel distribution immediately arise, for there appears to be no really potent plant source of the anti-rachitic vitamin. The forage grasses, lucerne, clover and sainfoin undoubtedly contain the vitamin, but in the case of the green vegetables, for example, spinach, lettuce and watercress, while they are rich sources of vitamin A, they contain only very small amounts of vitamin D. The vegetable oils, the cereals and their products, yeast, beans, and the fruit juices (for example, orange juice) appear to contain little or none of this vitamin.

At present we know that after exposure to ultra-violet radiations, the anti-rachitic potency of oils is increased and hence of foods which may contain them.

Ultra-violet Rays.

Freshly-cut green plant tissues on exposure to ultra-violet rays also show an enhanced anti-rachitic value. Living animals and animal products in the same way benefit by an increase in the amount of vitamin D when exposed to ultra-violet light for the optimum period. Ultimately the same effects are produced whether the ultra-violet rays are those present in strong sunlight or in the radiations from the quartz mercury vapour lamp. At present it is uncertain to what extent food and sunlight combine to supply the anti-rachitic vitamin in cows' milk, but exposure to sunlight in open pastures is probably the determining factor. This question is one of many requiring further experimental investigation.

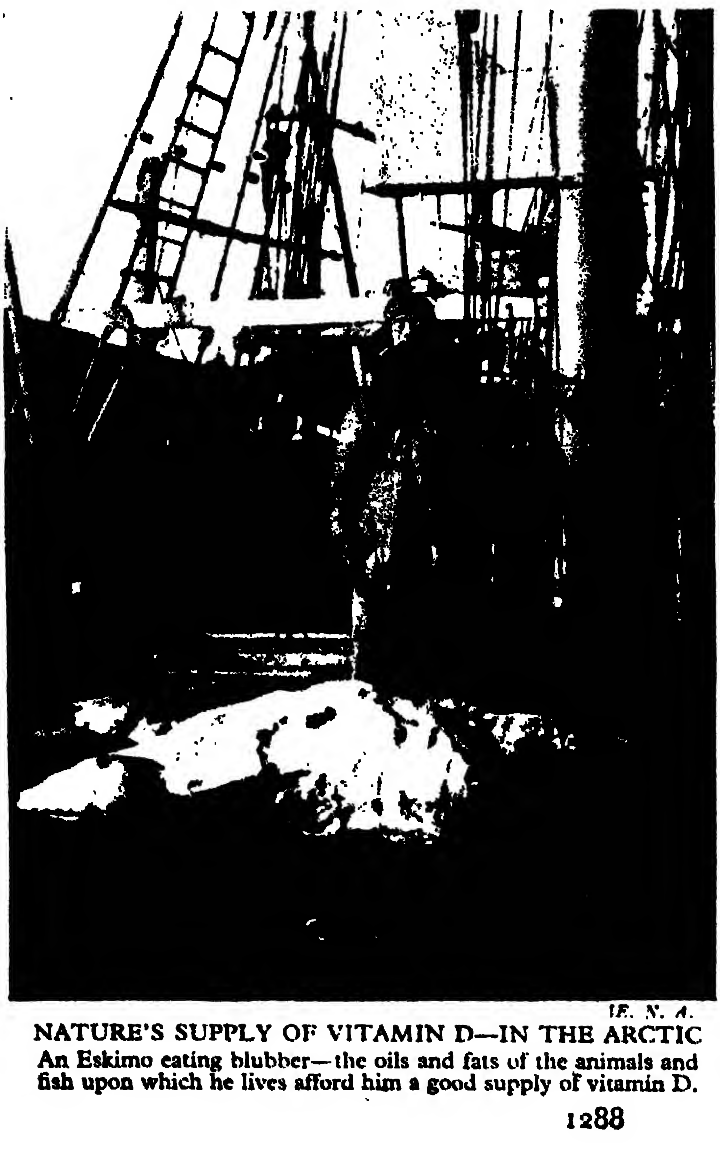
It seems probable that the direct irradiation of individuals in clinics and hospitals is likely to prove of more practical service than the wholesale irradiation of manufactured foodstuffs. With the exception of the liver oils, most manufactured foodstuffs are admittedly deficient in vitamin D. At first sight it might appear that all that was required was to submit the food material to ultra-violet irradiation. But in practice this is not a simple matter. The foodstuff can be exposed to the rays only in a fine layer if a solid, and as a thin film if a liquid, at a certain distance from the light source. The material must only be subjected to the rays for the optimum period (approximately half an hour), but if this period is exceeded destruction of the newly formed vitamin takes place. Thirdly, if the foodstuff already contains vitamin A, this factor will be destroyed simultaneously under the conditions of irradiation. Lastly, many foods, for example, milk, may be rendered unpalatable by exposure to ultra-violet rays.

In spite of these difficulties certain food products have been successfully irradiated on an industrial scale without diminution in their content of other vitamins present or impairment of their palatability. In the United States this has been achieved in the commercial manufacture of anti-rachitic dried milk.

Vitamin D is more stable than vitamin A, for it is much less readily destroyed by oxidation. In oily media it is probably

as resistant as any of the known vitamins to the effects of heat, oxidation and preserving. Hence in the ordinary domestic processes of cooking the anti-rachitic vitamin suffers little or no destruction. The body stores the vitamin, but to a much less extent than vitamin A. Vitamin D is unaffected by saponification and is present in the so-called unsaponifiable fraction of cod-liver oil (1 per cent.). This discovery has furnished a means of economic importance for the supply of potent concentrates of both vitamins A and D. The introduction of these fat-soluble vitamins into margarine and other vitamin-free products is now being carried out by manufacturers. Distinct from the behaviour of cholesterol (a constant constituent of the cells of animals), which closely accompanies it, vitamin D, like vitamin A, is not precipitated by digitonin. It is present in the final potent fractions obtained by vacuum distillation.

We are indebted to Zucker for an easy method whereby the vitamin D of cod-liver oil can be extracted without removing vitamin A simply by shaking out the oil with 95 per cent. alcohol. The material so obtained can be concentrated by saponification and other technical processes, and is in fact the basis of industrial methods in England and America for the production of commercial extracts of vitamin D.



E. N. A.

NATURE'S SUPPLY OF VITAMIN D—IN THE ARCTIC
An Eskimo eating blubber—the oils and fats of the animals and fish upon which he lives afford him a good supply of vitamin D.

It is now possible to trace the chain of new discoveries which enables one to understand how the invisible ultra-violet rays of the sun or the artificial lamp on the one hand, and the use of cod-liver oil on the other, are able to supply the anti-rachitic substance to man and the lower animals. With the notable exception of Mellanby's experiments on dogs, most of the experimental work on rickets has been carried out on rats. A chance observation showed that these animals, when restricted to a rickets-producing diet, did not develop the disease if their cages containing sawdust were exposed to ultra-violet light. But rats on the same diet in cages with sawdust, and under identical conditions except that they were not irradiated, developed rickets. It was observed that the healthy rats ate the irradiated sawdust. The light itself was therefore not the preventive agent but evidently something in the sawdust which had been activated by the rays.

The next step was to discover which particular constituent had been changed by the irradiation, and to this end a variety of

[W. F. Taylor

NATURE'S SUPPLY OF VITAMIN D—IN THE TROPICS
Natives of Nigeria feed largely on vegetable products and obtain their vitamin D from the sun.

foods of different sorts, all of which possessed no anti-rachitic properties, were irradiated.

Ergosterol.

It was found that the constituent in these foods which was activated by the ultra-violet light was only the fat and not the protein or the carbohydrate. Chemical investigation of the fats narrowed down the source of the anti-rachitic activity to the unsaponifiable fraction and finally to its association with the presence of cholesterol. For some while it seemed that vitamin D was simply irradiated cholesterol. Further researches in England and America showed that the cholesterol was impure and that the contaminating body was another substance closely related to cholesterol and called ergosterol. The name arises from the fact that ergosterol was first obtained from the ergot of rye. It was thus the ergosterol, the pro-vitamin or precursor of vitamin D, which Rosenheim and Webster found on exposure to ultra-violet rays to have acquired the property of preventing rickets, *i.e.* of becoming vitamin D.

Ergosterol is present in ordinary cholesterol only in one part in 2000, and no doubt this is the reason why it so long eluded the observation of chemists. The production of vitamin D by the irradiation of ergosterol offers a valuable means of eventually isolating the pure vitamin. These remarkable results are of special importance because they give the first clear proof of the fact that a vitamin is a definite chemical entity related to a known group of organic compounds - the sterols. Commercial enterprise has not been slow to exploit this newly acquired knowledge. Ergosterol occurs in appreciable amount in the fat of yeast and this has proved to be the most economical commercial source. However, as already pointed out, the unsaponifiable matter of cod-liver oil and other liver oils is proving a ready and cheap means of introducing both fat-soluble vitamins A and D into foodstuffs on an industrial scale.

Fortifying Foods.

Whichever method is adopted, it is certain that we shall soon see many staple foods such as margarine, butter, lard, honey, bread, flour, chocolate and sweetmeats fortified in their fat-soluble vitamin content. Irradiated ergosterol, when

carefully prepared, has the advantage over cod-liver oil of being practically tasteless. Moreover, it is remarkably active ; less than half an ounce of the pure substance after irradiation is regarded as sufficient to supply the daily ration of vitamin D for the average span of human life. Such an amount would cost at present market prices (1928) about £20 to £30. In assaying cod-liver oils and foodstuffs for their anti-rachitic value short feeding tests on young rats are usually carried out. This is followed at the conclusion of the experiment by chemical and pathological examination of the bones. Using this method it has been found that as minute a dose as .00005 of a milligram of irradiated ergosterol per head per day will completely cure rats of rickets. For children a dose of one milligram would probably suffice. But it should be remembered that there is evidence for believing that a large excess of vitamin D is very harmful to bone formation.

Sunlight and Vitamin D.

The foregoing facts explain many problems and reconcile many conflicting views. Thus it is evident that the age-long value of sunlight is due, in part at least, to the production of vitamin D by activation of the ergosterol present in the fat of the tissues underlying the skin. Man is dependent on his food, and particularly the vegetable portion, for his supply of ergosterol. Thus cod-liver oil can supply the anti-rachitic vitamin, as it were, ready-made, or it can be produced from the ergosterol present in the tissues of the body surface by the action of the sun. This explains why the native races of the tropics and the Eskimos in Polar regions rarely suffer from the disease. The former obtains his vitamin D requirements from the sun, the latter from the body oils and fats of the animals and fish upon which he habitually lives.

If the food contains neither vitamin D nor ergosterol (the pro-vitamin) the body reserves are correspondingly depleted, and no amount of ultra-violet radiation can prevent or cure rickets. In fact, such cases were encountered by Dr. Harriette Chick in her investigation of post-war malnutrition in Professor Pirquet's clinic in Vienna. In these cases cod-liver oil had to be administered, since a cure could not be effected by exposure of the patient to sunlight or ultra-violet light. These facts are of equal significance in animal husbandry. The ergosterol present in the forage grasses consumed by the cow becomes activated under its skin by the summer sunshine. The vitamin D thus formed is caught up in the blood-stream and is duly secreted in the milk. This accounts satisfactorily for the better quality of summer milk and butter. Recent research suggests that there is also some connection between the annual migration of birds and the production of vitamin D. Comparison of

[Judges, Ltd.

A LONDON FOG

The smoke and grime of a city fog completely prevent the passage of ultra-violet rays so necessary for the production of vitamin D.

THEIR PLACE IN THE SUN
Children on the shores of Lake Geneva obtaining the sunshine essential for their healthy development.

the amounts of vitamin D in the feathers of birds which have gone south to spend the winter with the amount in the feathers of similar birds kept in this country, shows a definite increase in vitamin D in the migrated birds. Thus the annual migration of birds in the autumn is very possibly the spontaneous response to the urge for the sun to ensure further supplies of vitamin D.

An appreciation of these findings has many other significant applications. First of all, the active ultra-violet rays cannot penetrate ordinary glass, nor, with the possible exception of artificial silk, clothing either. The subject must therefore expose his bare skin to the unimpeded rays. Wherever it is possible it is preferable to obtain one's ultra-violet light from the sunshine in the open air. To overcome the difficulty of those whose time must of necessity be largely spent indoors, special glasses have been devised which are more transparent to the curative rays. Windows glazed with such glass or with quartz are of value for hospitals, sanatoria, and sick rooms, but for ordinary purposes their use is superfluous. It should be remembered that such glass can only be beneficial in a clear, smoke-free atmosphere. In the darkened atmosphere of our industrial cities, the smoke and grime almost completely filter out the vital ultra-violet rays.

The health-giving ultra-violet rays can be measured in degrees by suitable means (the acetone-blue tube). The figures for different parts of the country are now published daily in *The Times*, and the following is an instructive example. For 1926 the monthly average of ultra-violet radiation at different places in degrees is shown below :--

Davos	5·0
Lyme Regis	3·7
Peppard (Oxford)	3·0
Hampstead	2·6
Kingsway	1·5
Hull	1·5

We can now understand why rickets has been, and still is, so prevalent and severe in slum areas and industrial districts. It also explains why the incidence of rickets annually rises to a maximum in the early spring after the close of the long sunless English winter. It is not merely carelessness but criminal folly that allows the atmosphere of our cities to be robbed of its ultra-violet rays through the wasteful system of pouring out smoke into the air from domestic and factory chimneys. It is for this reason that Dr. Saleeby has designated rickets as "the disease of darkness," and rightly claims that "the great outstanding need of our infants in this country is their place in the sun, to which they will never be restored until we have abolished the deadly pall of coal smoke."

In the present situation there is therefore a real necessity for the provision of holidays in the country for slum children, while the worker's fortnight at the sea is not a luxury but a necessary health investment to revitalise the body for the oncoming winter.

More drastic anti-smoke legislation is essential if the present evil is to be controlled, but the ideal way of solving the problem would be the immediate conversion of coal into electrical energy at the pithead. But to set up such a huge undertaking, even granted the necessary goodwill, is the task of years. In the meantime it is the duty of every one to diminish smoke as much as possible by using one or other of the different low combustion fuels now being made available as the result of scientific research. With the abolition of the smoke evil, not only would much disease automatically disappear, but our country, freed from the blackening hand of smoke, would be revealed beautiful beyond belief.

We live in a scientific age and science has found in the effects of sunlight on our bodies and our plants, an immense field for investigation. The more we learn about the action of the sun's rays on all living things the closer our dependence for well-being on the sun is seen to be. Not for nothing did primitive man worship the sun. "La fleur humaine," says Michelet, "est de toutes les fleurs celle qui a le plus besoin de soleil."

Open-air schools and sunshine clinics, provided they are in responsible hands, are an excellent practical means of carrying out the sun-cure (heliotherapy) in this country. Such schools are to be seen at their best perhaps in Switzerland, where Dr. Rollier's wonderful work has been carried out. All along the shores of Lake Geneva you may see school children and infants being "sunbathed" under official auspices. Not only rickets, but osteomalacia, lupus and many other forms of tuberculosis have been successfully cured by this means. From laboratory and clinic, evidence is steadily accumulating to show that sunlight increases the disease-resisting forces of the human body. Even with our present knowledge, limited though it be, the time is coming when rickets and tuberculosis will trouble the human race no more.

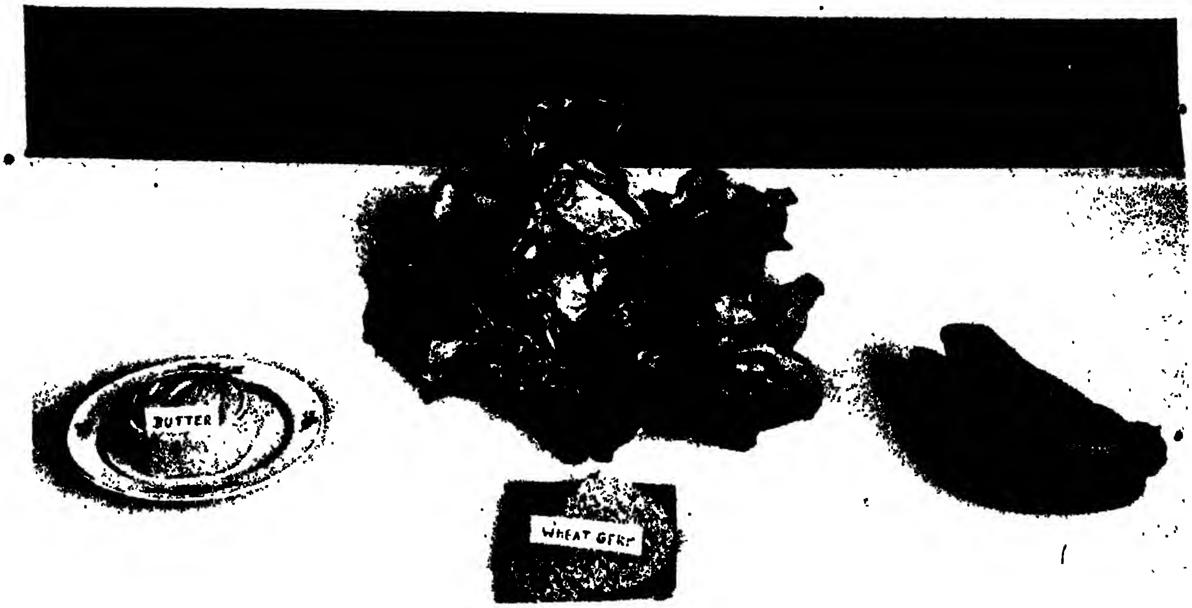
VITAMIN E

Vitamin E is the accessory factor whose presence in the food of mammals is essential to ensure normal reproduction. The announcement of its discovery in 1922, by Professor H. M. Evans and his co-workers in the University of California, did not create surprise, for it had long been realised that experimental animals fed on diets deficient in one or other of the vitamins, exhibited lowered reproductive capacity. Many hundreds of experiments by Evans, and independently by other investigators, have confirmed the existence of a specific fat-soluble substance, of the nature of a vitamin, which restores fertility to male and female rats rendered sterile by feeding on a specially purified synthetic diet deficient only in vitamin E.

In the absence of this reproductive vitamin, degenerative changes occur in the testes of the male. In the female, equally remarkable effects are exhibited in the resorption of the unborn young and sensitivity of all the fœtal tissues to withdrawal of the vitamin. While the mode of action of vitamin E in the body remains very obscure, the work of the American investigators has determined something as to its nature, properties and distribution.

Sources.

The plant kingdom contains the richest sources of vitamin E, wheat germ and especially the oil derived from it, lettuce leaves and pea seedlings being by far the most potent sources. Corn germ, alfalfa seed, lettuce seed, flax seed and polished rice are comparatively poor sources. The richness of certain vegetable tissues in this vitamin and the fact of its fat-solubility has focused the attention of investigators upon the vegetable oils. Most of these, for example cotton-seed oil and olive oil, contain the vitamin, but few in high concentration. The small amount present in cotton-seed oil appears to resist destruction in the industrial process of hydrogenation (*i.e.* the adding of hydrogen to the oil molecule by the agency of catalysts such as nickel and platinum in the manufacture of margarine, whereby a liquid oil is converted into a solid fat). Corn oil, walnut oil, peanut oil, flaxseed oil, are all indifferent



THE CHIEF SOURCES OF VITAMIN E

The vitamin which influences fertility is most abundant in wheat germ, lettuce, and bananas in the plant kingdom, and is more plentiful in butter than in milk.

sources of the vitamin. The question as to whether the oils of other cereals possess potencies comparable with wheat germ oil has been studied, but it was found that none possessed an activity comparable with that of the latter. The same holds good in the case of yeast. So far only a few fruits have been studied; the vitamin is present in the banana while traces only are found in orange juice.

In contrast to the plant kingdom, vitamin E is present only in very low concentration in the animal although it occurs in a great variety of tissues. It has been found in the muscle meat of the ox, rat and pig, and to a less extent in the heart. The fresh body fat of both the pig and sheep contains the vitamin, but lard appears to be devoid of it. A remarkable finding is the fact that the liver, which we have already seen to be a rich storehouse of the fat-soluble vitamins A and D, is low in its content of vitamin E. This vitamin also does not appear to be stored to any extent in other organs such as the spleen, kidney, and brain. Although vitamin E is needed for the manufacture of the sperm cells, it is not stored in appreciable amounts by the testes.

Storage in Animal Body.

In the animal body the chief storage place for vitamin E is in the muscles and the fat, but again in neither of these tissues is it present in high concentration. Milk is low in vitamin E, as is egg yolk, but dairy butter is a more abundant source, though varying with the quality of the rations of the cow. It is also noteworthy that the vitamin is always present in the tissues of the new-born young, being obtained from the mother during intra-uterine life. Special interest attaches to cod-liver oil as regards its vitamin E content because of the unique concentration in fish oils of the two other fat-soluble vitamins, A and D. Vitamin E is present in cod-liver oil in traces only, or may even be absent. Thus it will be seen that the distribution of vitamin E in nature is different from that of vitamin A or vitamin D.

Overdosage.

Administration to sterile rats of foods known to be two to twenty times as rich in vitamin E as is necessary for the inception of reproduction does not increase fertility beyond the normal limits. It is obvious that this result is one of great significance. Again in the case of vitamins A and D, the evidence shows that

no advantage accrues, but that harmful effects may result from overdosage.

Vitamin E withstands desiccation well, for when the leaves of lettuce or alfalfa are dried and powdered, they are still found to be active sources. When the oil from this powder is extracted with ether the vitamin has been shown to accompany it. Vitamin E is also readily extracted from dried wheat germ by ether, pentane, acetone, benzene or absolute alcohol; a golden yellow oil representing 10% of the germ is obtained.

Stability.

Like the fat-soluble vitamins of cod-liver oil, the reproductive vitamin E is very stable in wheat germ oil, the richest known source. Moreover, the wheat germ itself is a very stable source because it can apparently be dried without loss, in the presence of air, at temperatures well above the boiling point of water. The ordinary domestic processes of drying and cooking have no effect on the content of vitamin E in animal and plant foods.

Applying such knowledge as has been secured, Professor Evans and his school have succeeded in preparing very highly potent concentrations of this vitamin from wheat germ oil. Although these active fractions were admittedly of a conglomerate nature, these investigators were able to cure sterility in the rat with as minute a dose as 0.00025 gram per 100 grams body weight. It has also been shown that the molecule of vitamin E is built up of carbon, hydrogen and oxygen only. In conclusion, it should be remembered that with the limited knowledge at our disposal, the significance of vitamin E in human affairs is at present unknown.

TABLE OF VITAMINS

The following indications are given in order to furnish a rough idea of the content of the different fat-soluble and water-soluble vitamins in the principal foodstuffs. It should be observed, however, that the degrees indicated are, of course, only approximations. For example, a foodstuff containing + + + + of vitamin A would contain more than double the vitamin A present in a foodstuff given as + + in the Table.

A blank space means that definite information is lacking.

o means that the foodstuff in question has been investigated and that no vitamin could be detected.

Traces of vitamin are indicated as such.

+ a little of the vitamin is present.
++ a considerable amount of the vitamin is present.
+++ a good source of the vitamin.
++++ a very rich source of the vitamin.
† a good source of the anti-rachitic vitamin D.
‡ a good source of the anti-sterility vitamin E.

Cereals and their Products	A	B (Vitamins)	C
Barley whole grain	o	+ +	o
sprouted		+ +	+ +
pearl	o	? +	o
Maize, whole grain	+	+ +	o
meal, yellow	+	? +	o
white cornflour	o	o	o
embryo	+	+ + +	o
Millet, whole grain	+ +	+ +	
Oats,	+	+ +	o
sprouted			+
Oatmeal	o		o
Malt, kilned		o to + +	o
extract, commercial		o to +	o
Rice, whole grain	+	+ +	o
polished	o	o	o
embryo		+ + +	
Rye, whole grain	+	+ +	o
flour		+ +	
Wheat, whole grain	+	+ +	o
germinated	+	+ +	+ +
white flour	o	o	o
‡embryo	+ +	+ + +	
Cereals and their Products—con.			
Wheat bread, wholemeal	+	+ +	o
white flour	o	? +	o
Animal Fats			
Bacon fat	+ variable	o	[illegible]
Beef fat (suet)	+ + variable	o	[illegible]
Beef fat oil (oleo oil)	+ + variable		
‡Butter (dairy)	+ + +	o	[illegible]
†Cod-liver oil	+ + + +	o	[illegible]
†Other fish liver oils	+ + + +		
Cream	+ +	+ low	+ low
Ghee (Indian butter fat)	+ + +		[illegible]
Hardened fats (prepared from v. active oils)	+ + +		
Lard	usually o		
Mutton fat	+ but variable		
Oleo margarine	+ to + +		
Pig fat (kidney)	+ +	o	[illegible]
Whale oil, crude	+ +		

	Vitamins A	Vitamins B	Vitamins C
Vegetable Oils			
Almond oil	o		
Arachis oil (ground-nut, earth-nut, peanut)	+		
Cocoa-butter	o		
Cocoanut oil	o		
Cotton-seed oil	+		
Linseed oil	+		
Maize oil (yellow)	+		
Margarine (prepared from veg. oils or lard)	o		
Nut butter	variable		
Olive oil	o to +		
Orange-peel oil	+ +		
Palm oil	+ to + +		
Palm-kernel oil	+		
Rape oil	+		
Sesamo oil	o		
Soya-bean oil	+		
Legumes or Pulses			
Beans, haricot, dry	o	+ +	o
„ germinated		+ +	+ +
kidney	+ low	+ +	
navy	?	+ +	
Cowpeas, germinated			+ + +
Lentils,		+ +	
sprouted		+ +	+ +
Peas, fresh, green		+ +	+
dried, green	+ +	+ +	+
‡germinated	+	+ +	+ +
Soya beans	+ low	+ +	o
meal (cooked)	+	+ +	
Vegetables and Vegetable Products			
Artichokes		+	
Asparagus		+ + +	
Beetroot	low	+	
Beetroot juice	low		+
Cabbage, fresh green leaves (or their juice)	+ +	+ +	+ + +
fresh white leaves (or their juice)	o		+ + +
dried	+ +	+ +	+
cooked	+ +	+ +	o to +
tinned			+ +
Carrots, raw and young	+ +	+ +	+ +
dried, young	+	+ +	+
cooked, young	+ +	+ +	+
Cauliflower, boiled			+
Celery		+ + +	
Chard	+ +	doubtful	
Clover	+ +	+ +	
Coco-nut milk			o
Cress			+
Dasheen or Tare	v. low	+ +	
Endive			+ at least
‡Lettuce	+ +	+ + +	+ +
‡Lucerne (alfalfa, dried)	+ +	+ +	
Mangold	v. low	o	+
Mushroom (Agaricus campestris)	v. low	+ +	
Onion	o	+ +	+
sundried		+	+
Parsley		+ +	

	Vitamins A	Vitamins B	Vitamins C
Vegetables and Vegetable Products—con.			
Parsnips	low		
Pickled cabbage			o
Pollen		+ +	
Potato, raw	low	+	+ +
cooked 1 hr.		+	+
baked & dried		+	+
sun-dried		+	+
Pumpkin juice			+
Radish		+	
Rhubarb			+
Runner beans, green pods	+ +		+ +
Sorrel			+ at least
Spinach, fresh	+ +	+ +	+ at least
dried	+ +	+ +	
sun-dried		+	o
Swede juice	v. low	+ +	+ + +
heated			+ +
Sweet potato juice	+ +	+	+ +
heated 20 min. 92° C.			v. low
Turnips		+ +	+ at least
Vegetables, dried			o to +
Vegetable marrow juice			+ +
Watercress	+ + +	+ +	+ +
Fruits (Fresh)			
Apple (fresh)		+ low	+
conc. juice			+
Avocado (alligator pear)		+ + +	
Banana	+	?	+
Cloudberries			+ at least
Cranberry (juice)			v. low
Grape		+ low	v. low
juice, dried		+	o
Grapefruit juice (Citrus decumana)		+	+ + +
„ dried		+	+
Lemon juice—			
fresh	?	+	+ + + +
preserved			+ +
freed from citric acid and concentrated			+ + +
dried		+	+ + +
tablets			+ +
Lime juice, fresh	?	+	+ +
conc.			+ +
preserved			o to +
Orange cake (dried minced orange)			o to +
Orange juice			
fresh	+	+	+ + + +
old			+
heated			+ + + +
concentrated in vacuo	+	+	+ + + +
Tangerine (Naartje) Citrus nobilis			+ + +
Marmalade Peel	+ +	+	+ +
Pawpaw (Carica papaya)			+ +
Peach juice			+ +
Pear		o	+
Persimmon, Chinese			+ +
Pineapple			+ +

	Vitamins A	Vitamins B	Vitamins C
Fruits (Fresh)—con.			
Prickly pear (Opuntia decumana)		+	o
Raspberry juice			
Tomato, raw	++	+++	+++
tinned	++	+++	+++
heated			++
Dried Fruits			
Apples		v. low	
Bananas			
Cocum			v. low
Currants		o	
Dates		o doubtful	
Dried fruits, commercial (except peach)			o
Figs			v. low
Mango			
Peach		+	o
Prunes			
Raisins			
Sultanas			
Tamarind		o	+
Tomatoes	++	+++	++
Nuts			
Almonds	Poor as a class		Prob. absent
sprouted	v. low	++	+
Barcelona nuts	v. low	++	
Brazil nuts	v. low	++	
Butter nuts	v. low		
Chestnuts		++	
Cocoanut		++	
Filberts		++	
Hickory nuts		++	
Pea nuts	v. low	++	
Pecan		++	
Pine nuts		++	
Walnuts, black		++	
English	v. low	+++	
Meat and Fish			
Blood	doubtful		
Fish, white (*e.g.* cod, haddock, etc.)	o	v. low	
†Fish, fat (*e.g.* herring, salmon, etc.)	++	v. low	
Fish roe, cod (soft and hard)	+++		
Maconochie ration		v. low	
Meat, lean (beef or mutton)	?	+	low
extract		o	v. low
lean, dried		?	o
sterilised		?	
tinned		o	o
juice, raw			low
Ox, brain		++	
heart		++	
liver	++	+++	
Pig, brain		++	
heart	++	++	
kidney	++	++	
liver	++	++	++
Sheep, brain		++	
pancreas		++	

	Vitamins A	Vitamins B	Vitamins C
Milk and Dairy Products			
Milk			
†cow's, fresh summer	++	+	+
,, fresh winter	+	+	+ low
,, dried	++	+	o to +
,, sterilised	++	+	o to +
,, boiled	++	+	+
,, pasteurised	++	+	+
,, condensed, sweetened	++	+	+
,, protein-free		+	
,, skimmed	+	+	+
,, colostrum	+++		
human	+ to ++	+	+
Buttermilk	+	+	+
Casein, commercial	traces	traces	o
Cheese	++	o	
cream	+		
Lactic acid milk			+
Lactose (milk sugar)	o	trace	
Eggs, whole	++	++	o
†yolk	+++	+++	o
white	o	o	o
dried	++	++	o
Animal Feeding Stuffs			
Bran	o	++	o
Brewers' grains		o	
Cotton-seed meal	o	+	
Linseed cake (after expression of the oil)	++	++	
Hemp seed	+		
Oil cakes, generally	?+		o
Millet	++	++	o
Sunflower seeds	?	+	o
Alfalfa (lucerne)	++	++	++
Clover	++	++	++
Grass	++	++	++
Hay, immature grass		++	
mature grass		+	
Silage	+		o
Timothy	++	++	++
Yeast, dried	o	++++	o
Miscellaneous			
Beer, as now manuf.	o	o	o
home brewed			+
Chocolate			
Cider, fresh			+
Cocoa			
Coffee		?+	
Diatoms, marine (Nitzschia)	++++		
Honey	o	+	o
Glucose	o	o	o
Jam			
Pickles			
Seaweed (Ulva cladophora)	++		
Starch	o	o	o
Sugar	o	o	o
Tea decoction			o
Yeast, brewers'		+++	
extract, commercial	o	+++	o
autolysed	o	but variable	o
heated		+++	
Wine, red and white		++	

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HARVESTING THE SUGAR CANE.

Reapers bringing in the Sugar Cane (the source of sugar, rum and molasses) on a West Indian Plantation.

DIET AND HEALTH

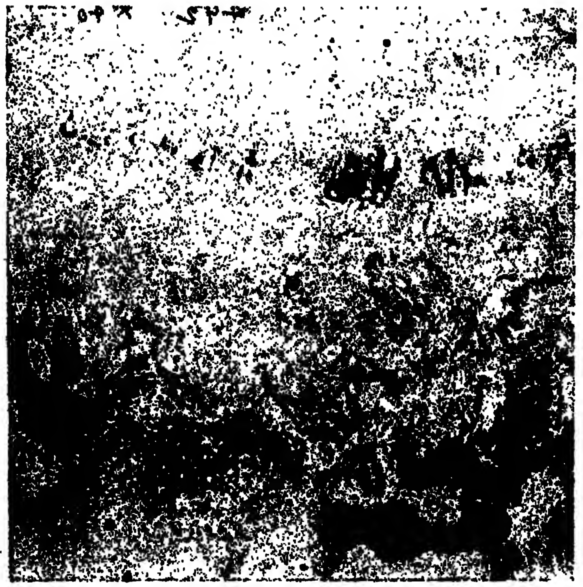
THE MINERALS

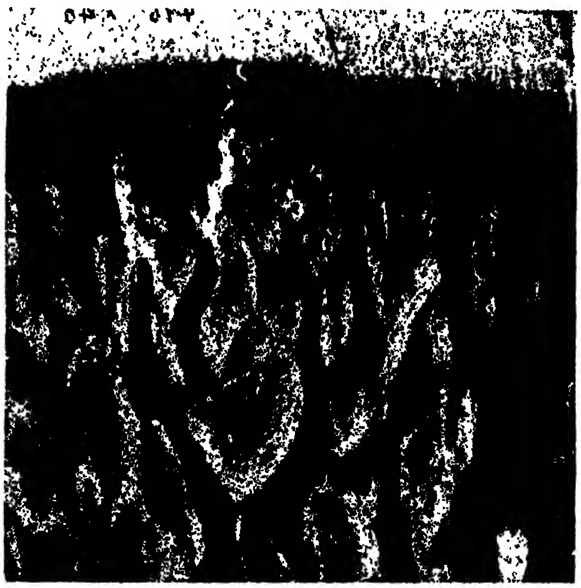
By S. G. WILLIMOTT, Ph.D., B.Sc., A.I.C., Government Analyst and Lecturer in Chemistry to the Government of Cyprus.

IT is never easy to hold the balance evenly between the many factors which go to make perfect health. Fashions sweep over science as they do over other spheres of life and, in matters of diet, lead only too often to an obsession with one particular group of factors. At present the vitamins, the discovery of which has so fired the popular imagination, still continue to absorb most public and professional interest. Apart from questions of protein and energy —factors which have long been appreciated in dietetics— there remains a class of indispensable substances, the minerals, whose importance to health is no less than that of the vitamins. Our knowledge of the rôle of the mineral elements in nutrition, though still very meagre, shows that they exercise a profound influence over that proper functioning of the organs of the body which constitutes health.

Mineral salts have three principal functions to perform in nutrition : (1) as the principal components of the skeleton ; (2) as indispensable constituents of the different organic tissues ; (3) as salts in the fluids and secretions of the body maintaining its functions, turgidity and alkalescence. About a dozen of these mineral elements are necessary for life. These are calcium, phosphorus, magnesium, iron, sodium, potassium, silicon, sulphur, iodine, chlorine and fluorine. It is possible that small amounts of arsenic, copper, manganese and zinc are also essential to life.

Of these indispensable elements, calcium and phosphorus are required in greatest amount for the bony framework of the body, two-thirds of which is composed of these two elements. Magnesium, silicon and fluorine are also present in the bones and teeth, but in much smaller amount. Iron is indispensable as a carrier of oxygen in animal life. In the plant iron appears to play some part in the formation of chlorophyll. In the blood of certain molluscs





From Report on Experimental Rickets] [*By permission of the Controller, H.M. Stationery Office*

HOW CALCIUM IS UTILISED IN THE BODY

Microphotographs (magnified 40 times) of a section through the bones of two young animals, the black stain indicating the calcium salts deposited in the growing bone. *Left*—Poor calcification due to defective diet. *Right*—Good calcification produced by a diet containing cod-liver oil and calcium acid phosphate.

(*e.g.*, snails) copper takes the place of iron in the oxygen-carrying pigment of the blood. Potassium is required particularly for the development of cells, especially those of the muscles, while sodium salts predominate in the blood. A deficiency of potassium usually results in poor muscular tone. Sodium salts enter into the composition of many of the secretions and fluids of the body and, along with the potassium salts, help to maintain the faint alkalinity of the blood and tissues.

Iodine is required by the thyroid gland for the production of thyroxin, one of the most important hormones or chemical messengers of the human body. Deficiency of iodine is the cause of most cases of exophthalmic goitre. Chlorine is used by the body chiefly in the form of inorganic chlorides, notably sodium chloride or common salt. From the chlorides the hydrochloric acid of the gastric juice is derived. Sulphur is required for the building up of protein and it enters conspicuously into the composition of the proteins forming the hair and nails. Sulphur is of use to the body only when in some form of organic combination. It has recently been discovered by Hopkins that sulphur in certain forms of organic combination is of much deeper significance in the work of the living cell than was ever suspected. The sulphur-containing constituent of the cell, which has been termed *glutathione*, has been shown to play a special rôle in oxidation, whereby the energy of the food assimilated is made available to the body for heat and work.

Manganese, copper, arsenic and zinc are present in the body in minute though varying amounts. Whether all or any of them are essential to life, or what special significance attaches to their presence in the body are still matters of debate. Arsenic has been shown to be a constant constituent of the living cell although its function remains unexplained. Copper is always present in the liver, and the newly born mammal appears to have a rich store of this element. Here again we are ignorant of its functions in the human body.

Special Mineral Needs.

The demand for mineral salts varies greatly with the age of the individual, with the food he is receiving and, in the case of women, with pregnancy and lactation. The mineral needs of the infant, for example, are widely different from those of the adult. The infant, which has to build up the bony framework of its body, can utilise comparatively large amounts of both calcium and phosphates supplied in the milk. The adult, on the other hand, loses much of the valuable bases, calcium and magnesium, in neutralising the excess phosphoric acid of the diet. Both young and old need all the inorganic bases of the unspoilt milk. But when milk is boiled the complex calcium and magnesium carbo-phosphates are broken down and thrown out of solution, and remain behind in the vessel with the skin which has been formed. The milk is thus deprived unnecessarily of its bases; milk need only be scalded, not boiled.

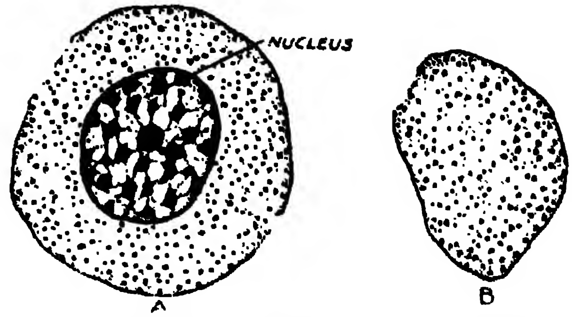
In pregnancy and lactation an increased demand for minerals is to be expected. When, however, these extra needs are not supplied in the mother's food, the maternal organism eventually robs itself of mineral salts to supply the fœtus. The damage to the teeth, and in severe cases to the bones, during pregnancy is an illustration unfortunately too common. An adequate supply of calcium in the form of dairy products and green vegetables in the mother's dietary would eliminate this unnecessary sacrifice.

Minerals are of the first importance in maintaining a normal state of the blood. A deficiency of iron, for instance, leads to a lowered production of hæmoglobin, the red pigment of the blood, and is one of the causes of anæmia. It is worth remembering that raisins, dates, prunes and spinach are foods specially rich in iron. A certain alkaline reserve is essential if the blood is to continue carrying carbon dioxide to the lungs to be exhaled. The heart itself cannot beat normally unless certain proportions of minerals are present in the blood which bathes its tissues. Blood flowing from a small wound cannot undergo clotting unless calcium salts are present.

The presence of both calcium and phosphorus in correct proportions in the blood, and therefore in the diet, is now known to be one of the main factors in the prevention of rickets. Administration of substances rich in vitamin D by the mouth, such as cod-liver oil, or exposure to ultra-violet radiation, increases the absorption of calcium and phosphorus from the intestinal tract. Here again we have no complete explanation of this remarkable effect, but recent results connect it with the state of acidity of those portions of the intestinal tract responsible for the assimilation of minerals. In tetany the calcium metabolism is disordered and the calcium content of the blood falls markedly; in rickets both calcium and phosphorus are concerned, but it is usually the content of phosphorus in the blood which falls considerably, and this is so characteristic of the disease that it is used extensively in diagnosis. An interesting illustration of this is to be seen in the seasonal variation of rickets. It has been observed that the phosphorus in the blood of infants rose during the summer months with the increase in the amount of ultra-violet rays in the sunlight, and fell in winter when the sunlight was negligible. The increase in the incidence of rickets was found to coincide with the fall in the blood phosphorus and a decrease in the amount of the ultra-violet rays.

Minerals and Digestion.

Mineral salts play an equally essential part in the digestion of food. An excess of bases such as potassium, sodium, calcium and magnesium ensures the conditions for the maximum utilisation of the proteins and reduces the tendency to form noxious products of digestion. In the stomach, food is digested or split up into its components by means of enzymes. The enzymes are the pivotal men of the human body. They break up large quantities of ingested food into its digestible units and yet never seem to wear out. But to do their work they must have the right conditions. The stomach enzyme, pepsin, must have a slightly acid medium in order to function; the enzymes of the pancreatic juice, trypsin, amylase, maltase and lipase act in a slightly alkaline medium.

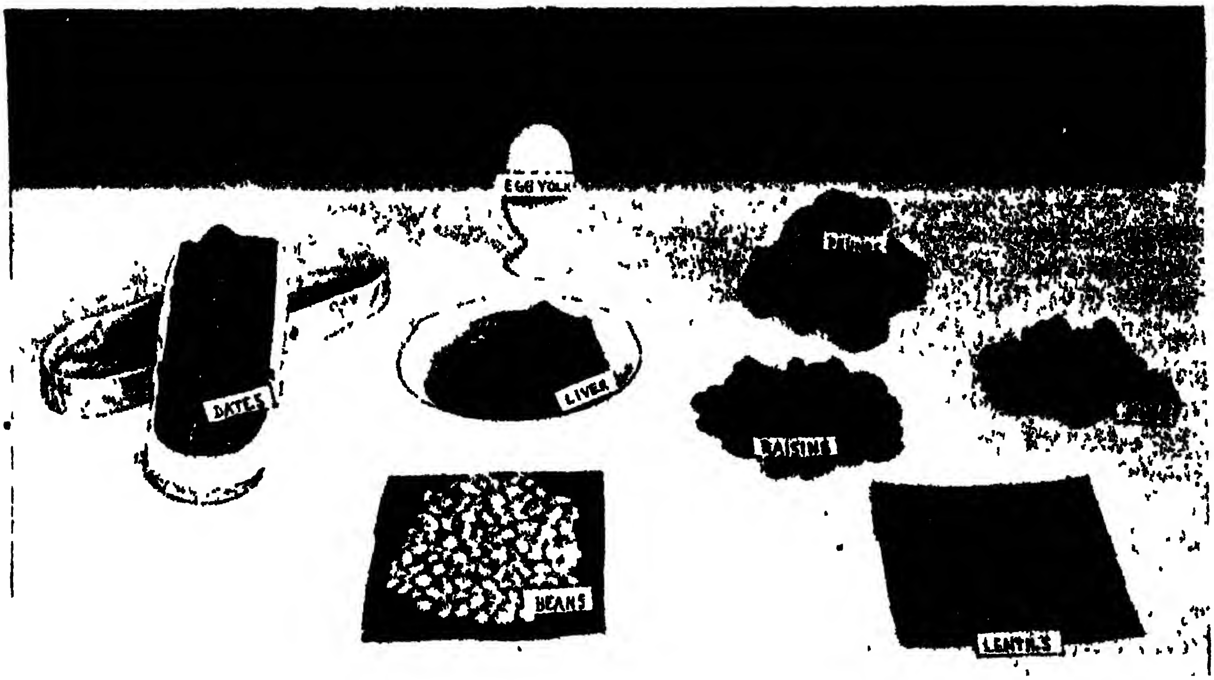


EFFECT OF CALCIUM ON THE HUMAN BODY-CELL.

A—A normal body-cell. *B*—A cell starved of calcium—the nucleus has disappeared.

The hydrochloric acid of the stomach is supplied by the common salt of our food, and this explains why we make use of considerable quantities. In the digestion of fats by enzymes, calcium salts greatly accelerate the process. Calcium salts tend to produce constipation while sodium and potassium salts have a tendency to produce diarrhœa. In the latter condition mineral salts are lost and consequently water retention is disturbed. This appears to be one of the reasons for the rapid loss of weight characteristic of this disorder, and for the beneficial effects following the administration of saline. In most unexpected situations we find mineral salts playing a vital rôle. One of the most striking of these is the fact that the permeability of the wall of the intestine to certain toxins is affected by the concentration of the mineral salts. Another is the dependence of certain of the ductless glands upon the minerals for their proper functioning. In the normal state the thyroid gland secretes iodine, arsenic and phosphorus bases, which play an important part in the formation of the skin, hair and nails, and in all the growth processes.

On the basis of its mineral content the food we eat can be divided into two classes, the acid-forming and the base-forming foods. As we have already seen, it is essential to health to have a reserve of the base-forming foods in the dietary. Meat, fish, poultry and eggs are all of acid character. So also are the chief representatives of the cereals, white flour and all the products derived from it



SOME IRON-CONTAINING FOODS

The dried fruits and pulses contain calcium and phosphorus also, and the egg supplies a small amount of phosphorus.

such as bread, pastries and cakes. They should be cut down to a practical minimum, and green vegetables, root vegetables, fruits, nuts, milk and the dairy products, all of which are base-forming foods, should take their place.

Cooked vegetables, such as cabbage, have most of the minerals boiled out of them. It is better to steam them for a short time. Potatoes should not be peeled but should be cleaned and baked in their jackets.

Some people are under a misapprehension as to the acid juices of fruit, such as the citrus fruits. Taken in reasonable amount, the organic acids in these fruit juices are completely burnt up in the body, leaving the incombustible residue of inorganic ash which is always alkaline. It is one of the kindly provisions of Nature that both minerals and vitamins are frequently found residing together abundantly in the same fruits and vegetables.

THE NEED FOR IODINE

By C. W. SALEEBY, M.D., Ch.B., F.R.S.E., F.Z.S., Founder and Chairman of the Sunlight League; Author of "Sunlight and Health," etc.

Just below the voice-box of each of us, except a few of the most unfortunate, is a small but potent and versatile gland, with two halves or lobes, one on each side of the neck, which is called the thyroid. It is the most important of the "ductless glands," essential for both sexes, but even more so for women notably in relation to motherhood than for men. Without its proper action neither the body nor the mind can develop.

Certain types of pitiful deformity and idiocy are due to its failure in early life. So is much obesity in later life, and recently a careful worker, Dr. Percy Stocks, in the Galton Laboratory in University College, London, has shown that failure and disorder of this marvellous gland are almost certain causes predisposing to cancer. His statistical inquiry has been done in conjunction with Professor Karl Pearson, F.R.S., and the evidence from the post mortem room agrees with the statistical conclusions.

Thyroid Health.

These varied instances show how vital for health of body and mind, at all ages, in the individual and for the race, is thyroid health. When this gland is unfairly treated it enlarges, in a variety

of ways, to which condition we give the name of goitre. This is one of the commonest diseases in the world, in every continent, and not least in our own country, as the modern low-necked fashion in women's dress has revealed. In 1895 it was found that the special stuff manufactured by the thyroid, and inimitable by any other gland, always contains a large proportion of the familiar element called iodine. Without iodine the thyroid gland cannot work. The gland cannot create iodine; nothing and no one can do that. Therefore, if we are to live, we must have enough iodine supplied to us somehow for the thyroid to use.

In 1917, it was found in America, and has since been abundantly confirmed in Switzerland and elsewhere, that large numbers of cases of goitre can be cured and that the occurrence of the disease in childhood and onwards can be prevented wholesale by the use of tiny doses of iodine. This had already been discovered more than a century ago, and forgotten.

But, indeed, we must not talk of "doses" any more, unless we should also talk of doses of, say, orange juice to cure and prevent scurvy. We see that iodine is, or should be, a natural and necessary ingredient of our food, and must be thought of henceforth accordingly.

It will also be used, more and more, by doctors as a drug, but even so, in nine cases out of ten, perhaps it will be as a food for the thyroid that it really serves the patient. There is a resemblance here between iodine and iron, for we know that iron is a valuable "drug" in many diseases just because it is a necessary food for the blood-forming organs.

A very large proportion of all cases of goitre are now seen to comprise another "deficiency disease" like the beri-beri and the scurvy which are due to absence of vitamin B and vitamin C respectively from the diet. The new discovery about iodine and goitre comes evidently into line with the discoveries about vitamins and their lack from the unnatural diet of our modern times.

Naturally we now ask where iodine occurs in an ordinary diet. In some natural and entirely unspoiled foods, such as wheat, we find iodine—without which the wheat could not have grown—but we find none in white flour. A similar contrast has been found by the chemists in analyses made at my suggestion between ordinary bran and the refined—perhaps far too refined—bran now specially prepared for medicinal purposes.

Unspoiled Foods.

And there is also the complication that much of the present soil of the earth is poor in iodine, which is a marine element, and the supply of which, left in the soil by the retreating æons of past geological ages, tends always to be washed away. Even entire unspoilt wheat from the "goitre belt" in the United States, for instance, where goitre abounds, may be almost destitute of iodine.

Cod-liver oil cannot quite be called a constituent of an ordinary diet; but this remarkable substance, besides being rich in certain vitamins, contains an important proportion of iodine, and in view of recent evidence I have no doubt that the iodine has really been the beneficent agent in many good results for which other constituents of cod-liver oil have hitherto received the credit.

Courtesy] [*"The Thyroid Gland," R. McCarrison (Baillière, Tindall & Cox)*

GOITRE—BEFORE AND AFTER TREATMENT

A disease of the thyroid gland largely due to lack of iodine in the blood.

The simplest way to restore iodine to our modern diet is to add suitable proportions of it, costing practically nothing, to the salt we use for cooking and at table. This is largely done on the Continent and in America and Australasia with splendid results. Since I determined, in 1924, to urge the value of iodine in our food in this country, after careful study of results abroad, many firms have put iodised salts upon the market. Their use should be universal.

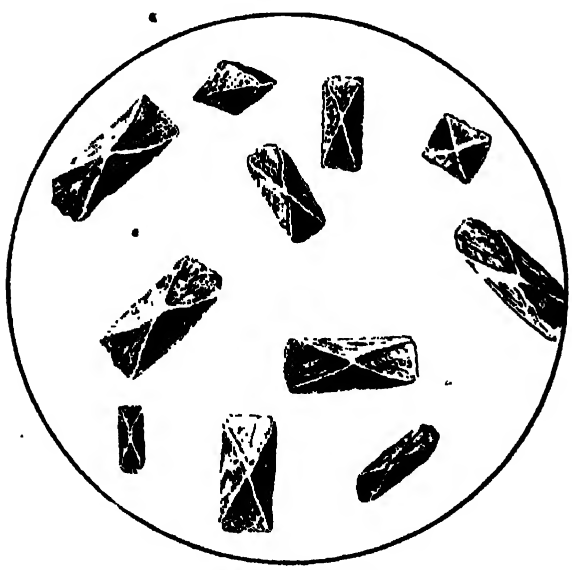
Iodised Salts.

Official inquiry into goitre and its prevention has already been begun, and the work done in this country has been most valuable and hopeful, as reference to the Special Report of the Medical Research Council will show.*

The School Medical Service has taken up the matter, and results surpassing my predictions are recorded from Cumberland, a very goitrous county.

Before very long the restoration of iodine to our national dietary will be accepted as one of the simplest and easiest applications of science to the public health. I was going to say cheapest, but the word is grotesquely inadequate for a measure, costing practically nothing, which abolishes disease on a vast scale, makes innumerable surgical operations unnecessary, and will much reduce the number of costly mentally defectives in the next generation.

* *Iodine in Nutrition*; H.M. Stationery Office, 1929.



CRYSTALS OF IODINE
An enlarged diagram showing the characteristic form of the blue-black crystals.

Of course, all patients suffering from goitre must be seen by a doctor. Enlargement of the thyroid gland may be due to many causes which only the doctor who sees and examines the individual cases can possibly determine. It is exceedingly satisfactory to be able to say that recent work by Professor Mellanby, Professor Francis Fraser, and others is showing the value of iodine against exophthalmic goitre as well as against the more familiar form of this disease.

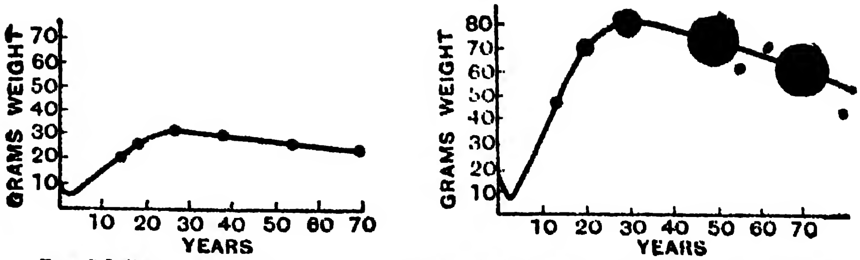
The prevention of almost all goitre and all the long list of consequences of "iodine starvation" can be achieved by the public for itself when it pleases to restore iodine to that mad medley, the diet of modern civilised man. Aided by the new official report we may now proceed further.

First as to the geography of goitre. The accepted teaching is that the disease is commonest farthest from the sea, which is the natural reservoir of iodine. Hence we quote Switzerland, Derbyshire, and the Middle West or "goitre belt" in the United States. But inquiry shows that proximity to the sea is very far from being a guarantee against this disease. Unfortunately, it is quite common in Cornwall, for instance; and it is so widely prevalent in New Zealand that the health authorities of that Dominion have already taken official action for iodine prophylaxis.

Two points may here be noted. The first is that, unless the prevailing winds be from the sea, bringing spray with them, mere proximity to it will not serve; and the second is that, wherever lime is abundant, far more iodine than otherwise is needed. There is a "lime-iodine ratio," as it is called by Colonel McCarrison, our leading authority on the subject. We certainly have much to learn yet about the geography and, if you like, the geology of goitre; but, in any case, no immunity whatever can be claimed even for small sea-girt islands like those of our own country or New Zealand.

Exophthalmic Goitre.

Second, there is the question of the existence of a remarkable type of goitre in which the gland is obviously over-active, the eyeballs are prominent and the pulse is fast. This is the opposite picture, in body and mind, to that of ordinary or endemic goitre. We call it exophthalmic goitre or Graves' disease in England, or Basedow's disease on the Continent. Ought we to take steps to guard such patients against too much—or any—iodine? Must we fear the production of large numbers of such cases if we adopt universal iodisation?



From "Iodine in Nutrition"] [*By permission of the Controller, H.M. Stationery Office*

THE GROWTH OF THE THYROID GLAND

Growth curves of the thyroid gland and its nodules: *left*, in "goitre-free" areas; *right*, in "goitre" areas (*from Aschoff*).

To these questions there are two answers. The first is derived from the splendid work of certain physiologists and physicians in our own country, amongst whom should be named Professor Edward Mellanby, F.R.S., of Sheffield; his colleague, Dr. S. J. Cowell; and Professor Francis R. Fraser, of St. Bartholomew's Hospital. These workers have proved that over-action in the thyroid in animals can be cured by the use of iodine, and that this wonderful element is a specific agent of therapy in human cases of exophthalmic goitre.

The very last thing here suggested is that readers who suffer from exophthalmic goitre should now begin to dose themselves with iodine. The size of the dose is all-important; and the constant rule for all cases of illness, including all kinds of goitre, is that the patient should see and be examined, and personally treated by a doctor. But the discovery that iodine is a specific, even in exophthalmic goitre, is a new and a most heartening one. As for the risk of producing this disease by the wide use of iodine, statistical inquiry is afoot. No proof of such a result exists; and the foregoing record of recent discovery shows how improbable any such result must be.

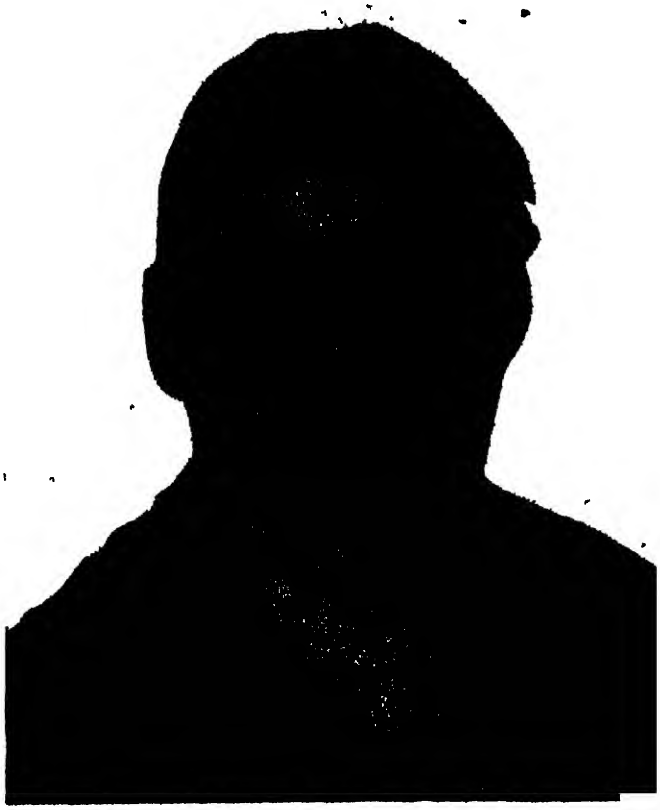
I return to the question of price. The first fact is that the quantities of iodine required are minute, and that their cost is simply negligible. But in England the cost of most of the iodised salts which have been put upon the market since I began my campaign is absurdly high, so that their general use is out of the question. On this matter I have recent information from Dr. H. Carriere, the secretary of the Swiss Goitre Commission.

The practice varies in different cantons. In some—as, for instance, Vaud—nothing but iodised salt is now allowed to be sold at all, a rule which now obtains also in some of the states of the American Union. In other cantons the law fixes the price of the iodised salt at the same level as the iodine-destitute salt. Until some such equality of price obtains in our own country no real progress can be made, and I cite the methods now spreading in Switzerland and the United States for the consideration of our own authorities.

A few quotations from the Medical Research Council's Report are so striking and significant that they should be read everywhere—as thus:—

In 1855 Koestl proposed the use of iodised salt in Austria, and Hambroso, in 1859, recommended that, as a means of preventing cretinism, all goitrous individuals of marriageable age should be treated with iodine. He also suggested that iodine should be administered to farm animals. It is worthy of note that these recommendations are in line with the results of the most recent work.

Of the recorded instances of the beneficial effects of iodine in goitrous districts, one of the most striking is the case of the canton



Courtesy] [“Exophthalmic Goitre,” F…son (Oliver & Boyd

A CASE OF EXOPHTHALMIC GOITRE

Showing the characteristically enlarged thyroid and staring eyes due to this disease, which can be cured b…

Appenzell. As a result of a vigorous campaign, the use of iodised salt became general in 1922. By 1925, it was reported that no more cretins were born and congenital goitre had practically disappeared.

In 1925, three workers in New Zealand found that goitre there occurred where iodine was scanty in food and drinking water, and that the disease could be prevented in school children by giving them potassium iodide in milk. “The New Zealand work,” says the Report, “thus supports the conclusions reached in the Swiss and American work.”

The assured knowledge which we now possess and which has been proved and found good in three continents, so that in many widely separated parts of the world none but iodised salt is allowed to be sold, must be now used for our own advantages in our own country. When, in 1924, I began to draw attention here to the meaning of what I had seen and learnt in Ohio and in Switzerland, I was assured that goitre is very rare in Britain, and that any general measures were therefore superfluous. But then Sir George Newman initiated a goitre survey of our school children—and that delusion has been dissipated. Nor, as we have seen, is goitre the only question, nor even the most important question.

When the thyroid gland is unable to function properly, normal nutrition is at once disturbed, resistance is reduced, the general health is lowered, and disease, in some form or another, calls for active treatment. In children of ten years and upwards the signs are especially noticeable, and include arrest of physical and mental development, nervousness, depression of spirits, defective memory, hesitating speech and loss of appetite, with constipation as an associated condition. In adults the signs are manifold and varied, and their true cause is often overlooked.

Every one interested in agriculture, and every one interested in animals, must study the need of living creatures for iodine. At the Zoological Gardens in London now, the lions and tigers, and several other animals, are receiving a special ration of iodine as part of their dietary, and I venture to predict that they will be found to benefit in much the same fashion as when vita glass was used to admit to them the whole, instead of an inadequate fraction of the light of life.

How much iodine do we need? The answer to that question is now being worked out, and it would be presumptuous to attempt to pronounce upon it. But the quantity, though absolutely essential, is certainly so moderate that the cost, to the individual or to the nation, of supplying our present iodine deficiency, will be entirely negligible. Would that all ameliorations of our lives and health were so inexpensive and easy, and safe and certain!

DIET AND HEALTH

DIET AND THE BLOOD

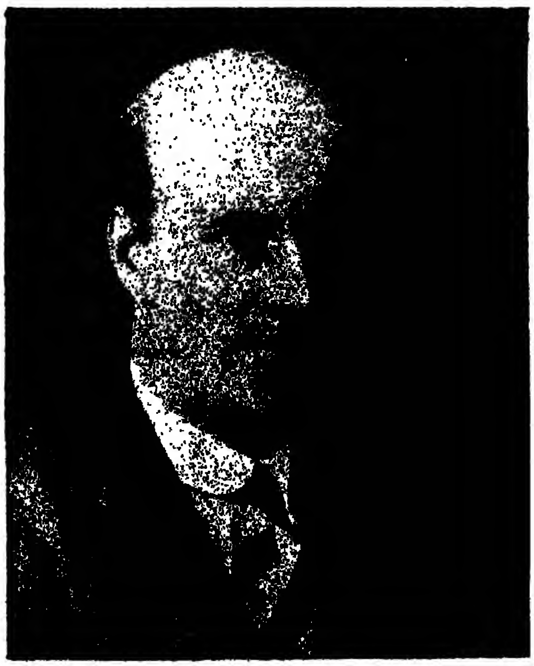
By J. S. BAINBRIDGE, M.Sc., Author of "The Human Machine," "Diet for the Million," etc.

JERRY-BUILDING never pays. The initial outlay may be lower, but the bills for annual repairs will be very much heavier than in the case of a building erected with greater care from sound materials. The same argument applies to the building of the human body. If it is to fulfil its purpose, the human embryo from the moment of its conception must be provided with the right building materials. Only by providing the right building materials is there any chance of the embryo developing into the fine human flower of which it holds the promise. Stint the building materials, and the result must be a stunted child easily susceptible to disease.

Good health is not simply the result of providing a certain amount of food, containing definite proportions of certain chemical elements, which is to be fed into the body at regular intervals. It never has been, and never can be, so simple as that ; but the question of the food supply is undoubtedly the one which has the greatest influence—for good or ill—on health. To ensure healthy growth, an alert happy childhood and a vigorous healthy adult life, an efficient diet must be provided—efficient in the sense that it is balanced and of the right kind. Evidence of the formation of the second or permanent teeth themselves can be seen at a very early stage in the development of the embryo ; and neither the teeth nor the bones, which are chemically very similar, can be properly built up unless the materials of which they are made, such as phosphorus and lime, are obtained *naturally* from the food eaten. Pregnant and nursing mothers, and growing children, must be fed on foods rich in phosphorus and the other mineral salts. No one would dream of giving a child who was suffering from a lack of phosphorus a stick of this very dangerous substance to chew.

The blood requires a small regular supply of iron if it is to carry out its duties satisfactorily. New muscle cannot be built up, nor old muscle, worn away by work or exercise, renewed, unless the diet includes minimal quantities of first-class (*i.e.*, animal) proteins, such as those found in milk. Yet other kinds of food (carbohydrates and fats) provide the energy with which we set about and complete our daily work, while the desirable activity of the bowels which will prevent constipation cannot be achieved unless the food contains roughage. Roughage, an American expression which has been absorbed into the English language, is the description given to the indigestible constituents of food which pass along the whole length of the alimentary canal, give bulk to and stimulate the ejection of the waste products, and finally make their evacuation a simple, easy and frequent operation.

After these various kinds of food have been eaten, a set of factors comes into play which is of vital importance the vitamins. Their action can be best understood, perhaps, if they are compared with policemen, for it is their duty to control the fate of the food in the body—to ensure, for example, that calcium is deposited in the growing skeleton in the most advantageous way—and, if the diet



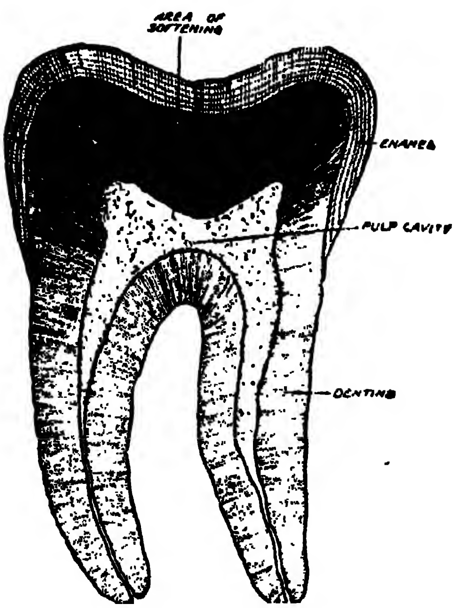
J. S. BAINBRIDGE, M.Sc.

lacks or is deficient in vitamins, diseased conditions sooner or later become manifest.

Thus, to supply the body with all the different types of building materials which it needs if it is to fulfil the old ideal of a sound mind in a healthy body, the diet must include adequate amounts of vitamins, mineral salts, roughage, proteins, carbohydrates and fats.

In addition to these requirements, it is desirable that food should be of such a nature that it materially helps the blood in its continual fight to preserve its alkalinity, an expression which will require explanation.

Acids and alkalies are well known, although not, perhaps, for their acid or alkaline nature. Vinegar is an acid (it contains acetic acid) and ordinary washing soda and ammonia are alkalies ; the acidity or alkalinity being detectable by means of indicators, of which there are many. If a blue cornflower, for example, is held in the fumes coming from a bottle containing an acid such as hydrochloric acid (spirits of salts), the petals will turn red, while a few drops of ammonia will quickly restore the blue colour. It is not always possible to secure a cornflower or red cabbage, etc., so that in practice not the natural plants but the colouring matters themselves, extracted and purified, are used as the indicators ; and the researches of the chemist have made available a large number of indicators whose colour changes are clearly defined and unmistakable.

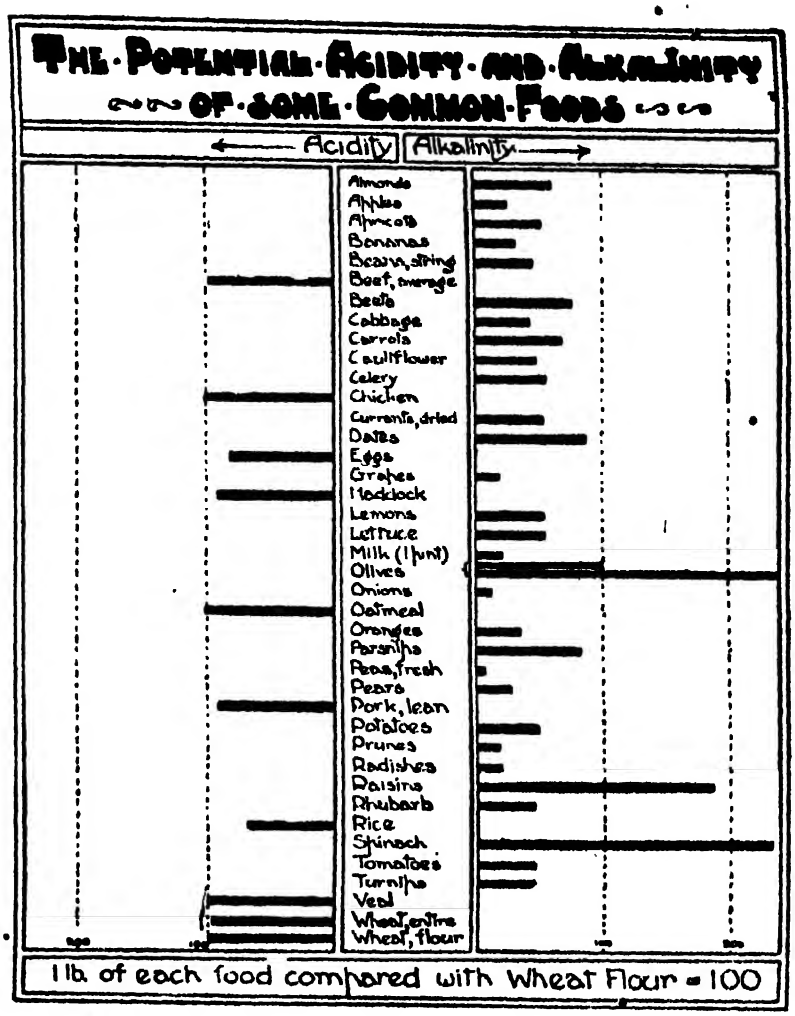


A RESULT OF FAULTY DIET
A "spongy" tooth, from which calcium has been extracted by the blood in order to supply its own deficiency.

Acids and alkalies are antagonistic. If the acid and the alkali have been present in exactly equivalent amounts, the mixture remaining will contain only a neutral salt—as, for example, sodium chloride, which is ordinary table salt—and indicators will assume a tint which is neither acid nor alkaline, but an intermediate shade. On the other hand, more acid or alkali may be present than is required exactly to neutralise the opponent, in which case the residual mixture will show which type is in excess.

The same sort of action is taking place continually in the blood, since the changes which foods undergo during digestion and absorption may produce acids or alkalies according to the nature of the foods, and it is extremely important that on balance the alkalies should predominate. Healthy blood is not neutral but slightly alkaline, and if it cannot obtain the required alkali from the food supplied it must withdraw a sufficient quantity for its needs from the bones and teeth. The skeleton and framework of the body may thus be attacked and weakened by the acids dissolving out some of the calcium, and the teeth may be similarly weakened from the inside by the same insidious action. This robbery from the teeth may proceed to such an extent that it is possible to find teeth which are more or less sponges covered with an outer coating of enamel. A casual examination may pronounce such a tooth to be in excellent condition, but a more critical inspection will reveal the damage. Acidosis must be present for a prolonged period to produce these and other serious defects—and severe acidosis, it may be noted, may be rapidly fatal—but long before this stage is reached the protective immunity to disease which is the most valuable asset of a healthy body will

have been destroyed. It is impossible to exclude the micro-organisms responsible for most of the human diseases entirely from the system. To live man has to breathe, and every lungful of air he inhales contains micro-organisms, some of which are bound to be of a pathogenic type. To live he also has to eat and drink, and pure food and water are unknown quantities. If the blood is in a healthy and slightly alkaline condition these invading harmful micro-organisms find themselves in a very unfavourable medium, and all their efforts to gain a permanent foothold are repulsed with comparative ease. If, on the other hand, the blood is not in its desirable healthy condition, the power to resist infection is lost, and it is merely a matter of chance which microbial disease will be contracted. Contact with a person suffering from a cold or measles, getting the feet wet on a cold day or any other factor will be blamed—except the right one.



Courtesy] [*J. S. Bainbridge, M.Sc.*

"PROTECTIVE" AND "DESTRUCTIVE" FOODS

The diet should contain a balance of "protective" (alkali-forming) foods.

The expression "acid-forming" which was used in an earlier paragraph should be noted, because it involves a principle which is of the utmost importance so far as the body is concerned. *Acid-forming* and *alkali-forming* foods are totally different terms from *acid* and *alkaline* foods. The juice of a lemon is acid, as a piece of litmus paper or any other indicator will promptly show, but in addition to the free acids (mainly citric) actually present, the juice contains a number of complex organic salts of potassium. If these are resolved into simpler compounds, as they are during the process of digestion, a residue is obtained which is strongly alkaline in character. The same result can be achieved in the laboratory by evaporating the juice to dryness in a platinum dish, and then heating the dish strongly until an ash of constant weight results. The potential alkalies in a lemon are present in such quantities that, when they are burnt up in the human furnace, they not only neutralise all the free acids, but they leave a quite definite alkaline balance upon which the body can draw to counteract the effect of acids produced from other foods. The lemon is at the same time an *acid food* and an *alkali-forming* food, and it is the credit alkaline

balance which gives to it much of its value *

Other foods contain an excess of acid-forming elements, and it is possible to estimate, from the determined chemical composition, the potential acidity or alkalinity of any food When this operation is performed, a general law becomes manifest which is easily remembered. All fruits and vegetables, and in addition, milk and its products, have a valuable alkaline balance. All cereal and animal foods, with the exception of milk, are definite acid producers. Once this important distinction is understood it is a comparatively simple matter to arrange a balanced diet, and without any hesitation it may be said that milk, fruits and vegetables will occupy a far more prominent position in this balanced diet than they do at present They are not luxuries, but vital necessities, and a diet poor in milk, fruits and vegetables is bound to be deficient in vitamins, roughage, mineral salts and alkali producers. In many cases these foods are the only sources of these vital elements, the supply of which is thus seen to be dependent *solely* on them.

Foods may be divided into the two classes – acid-producing and alkali-producing—and although this division at once marks off fruit and vegetables from cereals and animal foods, it does not differentiate between the members of each class. All fruit and vegetables have some value as acid neutralisers, but the most valuable are spinach, parsnips, carrots, lemons, raisins and beans. The diagram on page 1307 has been constructed from the analytical figures, and it shows in graphical form the potential acidity or alkalinity of a number of common foods. The values given are not absolute. Ordinary white wheat flour has been selected as a standard. Its potential acidity has been given a value of 100 and the remaining figures have been calculated on this standard. But, relative as the figures are, they effectively show the dangers of an unbalanced diet. It is obvious that in general the acid-producing foods produce, weight for weight, more acid than the alkali-formers can neutralise. Two lb of potatoes approximately balance the acid produced by 1 lb. of beef, while either 7 ozs. of spinach, 4 lbs. of apples or 5 pints of milk would have the same effect. Hence the larger the amounts of meat and cereal foods consumed, the more liberal should be the supply of compensating fruits and vegetables. The difference between wholemeal

* The human furnace is not quite so drastic as a blow-pipe In the laboratory the complex organic salts are burned to potassium carbonate, in the body to potassium bicarbonate a much less alkaline substance which is, however, still capable of neutralising acids The distinction is not sufficiently important to affect the above argument

Courtesy] [Glaxo, Ltd

A LABORATORY FOR FOOD RESEARCH

A view in the Glaxo Laboratory—testing different methods of treating milk.

ALKALI-FORMING FOODS REQUIRED TO BALANCE ACIDS
The quantities shown of spinach, potatoes, apples, and milk are sufficient to neutralise the acid-producing effects on the blood of one pound of beef.

and refined cereals may also be mentioned. Numerically it is not great, 15½ ozs. of refined flour having the same potential acidity as 16 ozs. of wholemeal flour. It has to be remembered, however, that cereal foods constitute by far the largest individual item in any dietary, as a result of which the difference in favour of wholemeal foods is more valuable than would at first sight appear

It is sometimes claimed that desirable as food reforms might be, most suggestions are impracticable because the family income is insufficient to provide any other diet. Analyses of the cost of foods have shown that the substitution of a diet containing more milk, fruit and vegetables, and less meat than is usual at present, can be achieved without any increased cost.

The great fault of modern diet is not lack of quantity, but lack of quality and balance, over-insistence on the importance of meat and inappreciation of the difference between manufactured and natural foods. No improvement in the general health of the community can be hoped for until these defects have been remedied. A good mixed diet, containing more milk, fruits and vegetables, and less meat than at present usually obtains, should be planned; and, apart from the expenditure on cereal foods and fats, the relative amounts of which are determined within rather narrow limits by the economic position of the family, the food allowance should be divided into three approximately equal parts. One third, *or more*, should be spent on milk and cheese, aiming at a minimum per person per day of 1 pint of milk; one-third should be spent on fruit and vegetables; and one-third, *or less*, on meats and fish.

If these food proportions in the dietary were generally adopted, there would result an enormous improvement in the national health, and this would be accompanied by a remarkable saving to the national purse. Excessive meat-eating is expensive in money and health. A distinguished physician* has said that "There is more permanent harm done by excessive meat-eating in a month than is accomplished by excessive gin-drinking in one year"—which is a grave indictment of our modern dietetic habits and a warning which we cannot afford to neglect.

* Dr. Leonard Williams.

THE ECONOMICS OF DIET

THE FAMILY FOOD BUDGET

By J. S. BAINBRIDGE, M.Sc., Author of "Economic Housekeeping," "Diet for the Million," etc.

DIETETIC science and dietetic economics have not yet met. Answers are sought to the questions: What is the amount of food necessary, and how much ought it to cost? How much food is required by a working-class family? And what percentage of the family income ought to be spent on it?"*

Theoretical knowledge must be translated into actual experience, and the object of this section is to show how a knowledge of the composition of foods may be used to plan the provision of a sound diet at as economical a price as possible. The word economical is here used quite deliberately, because the amount of money spent on food represents by far the largest item in the expenditure of any average family. The Report of the Royal Commission on Food Prices (1925) states that more than "60 per cent. of the national income is spent on food," and it is easy to understand that, if the quality of the diet can be improved by, say, 10 or 20 per cent. without increasing the amount spent on food, very material improvements in the general health of the community might be expected in a reasonably short time.

The problem centres round three questions:

(1) What amounts of each kind of food are required to create and maintain health?

(2) How cheaply can these foods be obtained?

(3) How shall such foods be prepared and served—which involves discussion of the construction of menus and family food budgets and of scientific household shopping?

Health Food Requirements.

It is obvious that some scale of measurement must be adopted before any estimate of the amount of food required can be made. Most food which is eaten is burnt up in the body furnace and, as is always the case when combustion takes place, heat is evolved. A unit for measuring the heat value of foods is therefore required and we have this in the large calorie, which is the amount of heat which must be passed into 1000 grams of water (about 2½ lbs.) to raise its temperature through 1 degree centigrade. The calorific value of any food is the number of heat units or calories which it evolves when it is completely burnt.

The simplest method of measuring the calorific value of a food is to determine the percentages of protein, fat and carbohydrate† in that food and, from the known calorific values of the three classes, to estimate the heat value of the food as a whole. The combustion of food in the body is not quite complete, and various deductions from the theoretical figures have to be made for incomplete digestion and incomplete breakdown of proteins—the calorific value *to the body* of one ounce of each of the three main types of foodstuffs is :—

Carbohydrate, 113 calories; Fat, 255 calories; Protein, 113 calories.

These figures are lower than those used in the standard tables (*e.g.*, Plimmer and Atwater), because in the latter no allowance is made for incomplete digestion.

Total Energy.

Every food, therefore, has a definite calorific value, and is capable of supplying the human machine with an amount of energy equivalent to this calorific value.

To keep the human machine working and to provide a surplus which may be used in any desired way (gardening, walking, and all the varied occupations which constitute the "daily round and common task"), food having a certain calorific value must be provided each day, just as a certain quantity of petrol must be fed to a car for every mile

* *The Medical Officer*, July 31, 1926.

† Mineral salts, vitamins and water, although essential constituents of the diet, have no calorific value.

of road it has to cover. The requirements of men performing different kinds of work, of women and of children are, as would be expected, not the same, and factors such as height and weight make an appreciable difference. Adopting the daily requirement of an average man (weight 154 lbs.) as the standard—it is 3,000 calories—and representing it by the index figure 1, responsible scientific opinion agrees that the food requirements of children and of different classes of adults are approximately as follows :—

TABLE I

Average Daily Energy Requirements of Adults and Children

Class.	Index.	Calorific Value.
(*a*) MEN :—		
1. Heavy manual workers	1.50	4,500
2. Moderately heavy manual workers	1.33	4,000
3. Rather heavy indoor work or light outdoor work	1.25	3,750
4. Moderately heavy indoor work	1.20	3,000
5. Sedentary workers with a fair amount of exercise	1.00	3,000
6. Sedentary workers with little exercise	0.90	2,700
(*b*) WOMEN :—		
7. Average woman four-fifths weight of average man	0.83	2,490
(*c*) CHILDREN :—		
8. Boys, after 14 years ..	1.0	3,000
9. Girls, after 14 years ..	0.83	2,490
10. Children, 12-14 years	0.78	2,350
11. „ 10-12 „	0.70	2,100
12. „ 8-10 „	0.63	1,900
13. „ 6- 8 „	0.57	1,700
14. „ 4- 6 „	0.51	1,500
15. „ 2- 4 „	0.47	1,400
16. „ under 2 „	0.40	1,200

These indices are *average* indices only, and may, therefore, be misleading if applied too rigorously, but in all cases they indicate the *minimum* calorific value which it is desirable that the food supplied should possess. An active child of 8-10 years may sometimes consume food to the value of 3,000 calories or more per day, and a tall, active woman may have a higher factor than her less active husband.

These indices are used to estimate the "man-value" of families. Let us take the case of a working-class family, with three children aged 12, 10 and 7. The father does moderately heavy physical work, and the mother is the average for her sex. The man-value of the family is, therefore, 1.25 + .83 + .78 + .70 + .57, or 4.13 ; and the food supplied should have daily and weekly calorific values of 12,390 (3,000 × 4.13) and 86,730 (3,000 × 4.13 × 7) respectively.

Protein Ration. We have already seen that foods contain two kinds of protein—animal or first-class protein and vegetable or second-class protein. The question as to what constitutes the ideal protein ration is still being widely discussed, but the results of a large number of physiological and statistical inquiries enable us to suggest a figure which is probably not very wide of the mark. Three and a half ounces daily is the amount to be provided. Of this, a minimum of 1 ounce should consist of animal (*i.e.*, first-class protein); the remaining 2½ ounces consisting of lower grade (*i.e.*, vegetable) protein. Since every one eats bread and other grain foods, every one is bound to eat moderately large quantities of vegetable protein, and we need only concern ourselves with the 1 oz. of first-class protein required. In passing it may be noted that approximately 1 oz. of first-class protein is contained in :

8½ oz. bacon, medium fat	6 oz. lamb
7 oz. bacon, lean	8 oz. mackerel
5 oz. beef	1¼ pts. milk
4 oz. cheese	6½ oz. mutton
8 oz. cod	6½ oz. pork
4 eggs	6 oz. salmon, fresh or tinned
6 oz. haddock	
4½ oz. herrings, smoked	6 oz. veal
	6 oz. sardines

The total daily ration of 3½ ounces of protein furnishes 400 (113 × 3½) of the 3,000 calories required. This leaves 2,600 to be provided by carbohydrates and fats. Fats being, comparatively speaking, costly foods, in practice it is found that the fat consumption is low (1½ to 2 ozs. daily) where the total expenditure on food is low, and high (3½ to 4 ounces) where better material circumstances exist. An average of 2½ ozs. is a reasonable compromise. This amount of fat furnishes 637 calories, leaving 1,963 to be supplied by the carbohydrates, a task

rather more than fulfilled by 17½ ounces (calorific value, 1,977).

The amount of fuel food required *per man-unit* per day is therefore :—

3½ ounces of	protein	with a fuel value of	400 calories
2½ "	fat	" "	637 "
"	carbohydrate	" "	1,977 "
			3,014

Chemical analysis of the body reveals the presence of fourteen or more mineral elements, but for practical purposes the only three which need be considered are calcium, phosphorus and iron. The foods which contain these three mineral elements contain, naturally, the minute quantities of the other necessary but less familiar ones.

Mineral Salts.

Fruits, vegetables and milk are the main sources of all the mineral elements, as they are also of the vitamins, but the amount of each which is present in different foods varies enormously. A food which is a good source of one mineral element is often a poor source of others (*e.g.*, milk, which is rich in calcium but poor in iron), and unless the diet is varied mineral salt starvation of one kind or another is almost certain to occur.

The amounts of the three mineral elements under consideration which are required per day are :—

Calcium, 1/20 ounces ; Iron, 1/1,900 ounces ; Phosphorus, 1/10 ounces,

and the cost of supplying these amounts from different foods is shown in Tables V., VI. and VII.

It is impossible to give any definite figures as regards either the vitamin content of different foods or as regards the minimum quantities required to maintain health, but it is known that some foods are better vitamin foods than others, and from the list provided it should be possible to make a suitable selection at any time of the year. The question of a balanced diet, which is supremely important, is dealt with later.

Vitamins.

COST OF FOOD

It has been shown that all food requirements come under one of four heads—energy value, protein, mineral salts and vitamins—and we have now to prepare graduated lists showing which foods supply each requirement at the lowest possible cost. By comparing the actual food consumed with the items given in these lists, it can at once be seen whether there is likely to be deficiency of any one requirement or whether too much is being paid for it.

Market prices vary considerably from week to week, it is true, but adjustments to the lists due to price changes are easily made. For example, when cheese is 1s. 4d. per lb. the cost of 1 oz. of first-class protein is 4d. If the price is reduced by a half to 8d. per lb., then the cost of the protein ration is reduced to 2d., and, on the other hand, if the price should advance to 2s. 8d. per lb., the daily protein ration would cost 8d. In order to simplify the problem as much as possible no analyses are quoted. Table II. shows the price per lb. of a large number of foods. These prices have been used in the preparation of Tables III. to VII. and are given so that adjustment due to price changes may be made when necessary ; Tables III. and IV. give graduated lists showing how the costs of the daily energy ration and of first-class protein vary, and Tables V., VI. and VII. similarly treat calcium, phosphorus and iron. All values have been worked out on the raw foods, but allowance has been made for waste due to bones, shells, pips and so on.

TABLE II

Cost per lb. of Foods used in Construction of Tables III.-VII. (E, English ; I, Imported)

Food.	Cost/lb. E.	Cost/lb. I.
BEEF		
Ribs	1s. 5d.	10d.
Round, lean	1s. 8d.	1s. 2d.
" medium fat	1s. 8d.	1s. 2d.
" fat	1s. 8d.	1s. 2d.
Corned Beef		1s. 0½d.
Suet		1s. 2d.
BEEF, SALT		
Brisket	1s. 6d.	7d.
Flank	10d.	6d.
VEAL		
Breast	10d.	
Loin	1s. 8d.	
Neck	1s. 6d.	
MUTTON		
Leg	2s. 0d.	1s. 6d.
Loin	2s. 0d.	1s. 4d.
Neck	1s. 4d.	10d.
Shoulder	1s. 7d.	10d.

FOOD REQUIREMENTS IN DIFFERENT OCCUPATIONS

An exhibit designed by the German Hygiene Museum. The figures on the left show the daily output of energy—and, therefore, the relative food requirements—in different occupations; in the centre are the woodcutter and the football player; towards the left, the tailor and the cobbler; towards the right, the typist.

Food.	Cost/lb. E.	I.
LAMB		
Leg	2s. od.	1s. 6d.
Loin	2s. od.	1s. 4d.
Shoulder	1s. 7d.	10d.
POULTRY		
Chicken	1s. 7d.	
Duck	1s. 6d.	
Goose	1s. 3d.	
Turkey	1s. 10d.	
Rabbit, fresh	8d.	
„ tinned	1s. 2d.	
PORK		
Leg	1s. 4d.	
Loin, middle	1s. 10d.	
Shoulder	1s. 4d.	
Bacon, average	1s. 6d.	
Ham „	1s. 7d.	
FISH		
Cod	9d.	
Cod Steak	10d.	
Haddock, fresh	8d.	
„ smoked	9d.	
Hake	1s. od.	
Halibut	1s. 6d.	
Herring, fresh	6d.	
„ kippered	10d.	
„ bloater	9d.	
„ salt	6d.	
Mackerel	5d.	
Plaice	1s. od.	
Salmon, fresh	2s. 6d.	
„ tinned	1s. 1d.	
Sprats	3d.	
Whiting	6d.	
Whitebait	3d.	
DAIRY FOODS		
Eggs, duck	2s. 6d.	
„ hen	2s. 9d.	

Food.	Cost/lb.
DAIRY FOODS *Contd.*	
Milk, whole	2½d. (6d. quart)
„ skimmed	1½d. (3d. quart)
„ condensed	2s. od.
„ condensed, sweet	2s. 1d.
Butter	1s. 10d.
Cheese, average	1s. 4d.
Lard	1s. 4d.
Margarine, animal	11d. & 1s. od
„ vegetable	7d.
FRUITS	
Apples	6d.
Bananas	8d. (5)
Cherries	1s. od.
Lemons	4d. (1 = 4-5 oz.)
Oranges	3d.
Pears	6d.
Plums	6d.
Strawberries	8d.
FRUITS, DRIED	
Currants	8d.
Dates	3d.
Figs	6d.
Prunes	9d.
Sultanas	8d.
Raisins	6d.
NUTS	
Almonds	1s. od.
Brazils	1s. od.
Hazelnuts	1s. od.
Walnuts	10d.
VEGETABLES	
Asparagus	2s. 6d.
Beans, scarlet runner	4d.
„ butter	3d.

Food.	Cost/lb.
VEGETABLES - *Contd.*	
Beets	3d.
Cabbage	2½d.
Carrots	1½d.
Cauliflower	4d.
Celery	3d.
Lettuce	10d.
Onions	2d.
Parsnips	1½d.
Peas, green	5d.
Potatoes	1½d.
Spinach	4d.
Tomatoes	8d.
Turnips	1½d.
Watercress (1d. bunch)	1s. 4d.
VEGETABLES, DRIED	
Peas	4d.
Lentils	4½d.
Beans, haricot	2½-4½d.
,, broad	
GROCERIES	
Biscuits, average	11d. to 2s. 9d.
Bread, white	2½d.
,, wholemeal	2½d.
Chocolate, average	2s. 0d.
Cocoa, average	2s. 0d.
Cornflour	6d.
Flour, white	2½d.
,, wholemeal	2½d.
Honey	10d.
Jam, average	10d.
Marmalade	9d.
Macaroni	4d.
Oatmeal	2½d.
Rice	3½d.
Sago	4d.
Sugar	3½d.
Tapioca	3d.
Treacle	6d.

1. COST OF ENERGY RATION

TABLE III

Cost of 1,000 Calorie Portions of Some Common Foods.

(*Note.*— Prices are graduated in Tables III., and IV.; that is, foods appearing at the beginning of each group are cheaper than those appearing later. Thus in Group 3, Table III., dates supply 1,000 calories for 3d., cornflour for 3½d.)

Group.	Foods.	Cost of 1,000 Cals.
1.	White flour, wholemeal flour; oatmeal; haricot beans.	less than 2d.
2.	Tapioca; bread (white and wholemeal); rice; margarine (veg.); macaroni; sago; peas (dried).	2d.—3d.
3.	Dates (dried); lentils (dried); margarine (animal); butter beans (dried); cornflour.	3d.—4d.
4.	Suet; figs (dried); lard; sprats; BEEF BRISKET (I.); BEEF FLANK (salt, I.); raisins; treacle.	4d.—5d.
5.	*Potatoes*; currants (dried); LAMB BREAST (I.)	5d.—6d.
6.	Marmalade; BUTTER; SALT HERRING; *parsnips*; sultanas; BACON; honey; BEEF BRISKET (salt, I.)	6d.—7d.
7.	*Artichokes* (Jerusalem); biscuits; BEEF FLANK (salt, E.); almonds; brazils; walnuts; prunes.	7d.—8d.
8.	MILK (whole); arrowroot; butter beans (fresh); CHEESE; chocolate; jam; skimmed milk; beef brisket (E.); beef ribs (I.); FRESH HERRINGS; *carrots*; corned beef.	8d.—10d.
9.	Beef flank (E.); cocoa; MACKEREL; lamb breast (E.); goose; leg of pork.	10d.—1/-
10.	Ham; *turnips*; apricots (dried); BLOATER; KIPPER; pork loin; beef ribs (E.); veal breast; leg of lamb (I.); plums.	1/-—1/6
11.	Oranges; rabbit; peas (fresh); onions; beets; salmon (tinned), leg of mutton (I.); cabbage; leg of lamb (E.); round of beef (E. av.).	1/6—1/11
12.	Pears; leeks; grapes; scarlet runner beans (fresh); bananas; leg of mutton (E.); apples; lemons; WHITING; cauliflower; chicken; COD STEAK; loin of veal; SMOKED HADDOCK; FRESH HADDOCK.	2/-—3/-
13.	Cherries; vegetable marrow; spinach; SALMON (fresh); celery; COD (whole); strawberries; EGGS; rhubarb; HALIBUT; PLAICE; tomatoes; TURBOT; SOLE; lettuce (11*s.* 5*d.*); peaches (12*s.* 6*d.*); pineapple (fresh) (17*s.* 6*d.*); asparagus (£1 4*s.* 6*d.*).	above 3/-

It must be remembered that the energy requirement is only one requirement out of four, and that the protein ration, mineral salts and vitamins are all equally important and must be considered when any diet schemes are being planned. Even remembering this, however, several facts stand out quite prominently :—

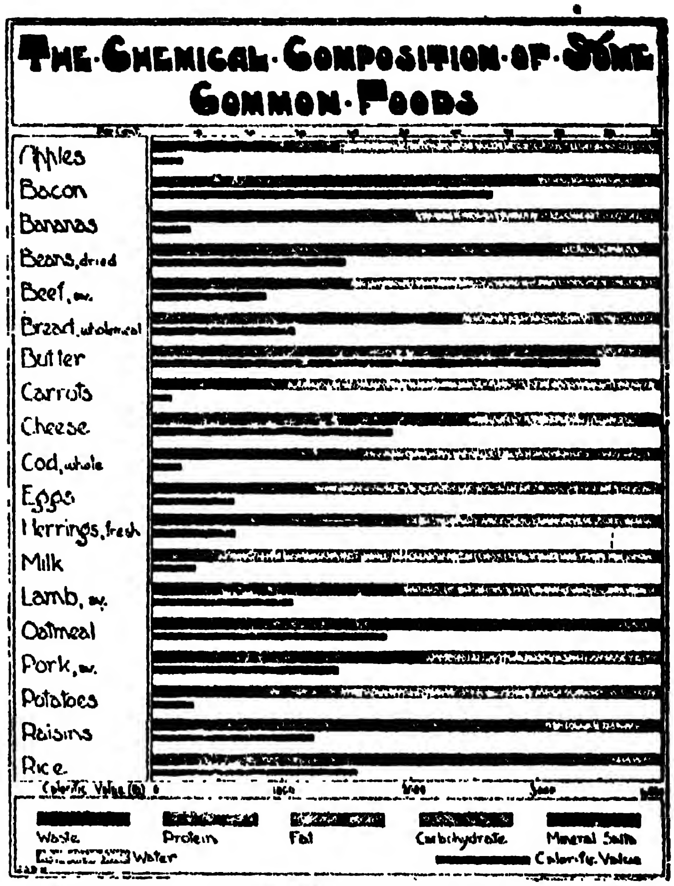
(1) The daily calorie requirement per man (3,000) *may cost as little as 4½d. or as much as £1 4s. 6d.*

(2) Cereal foods, dried fruits, pulses and one or two of the cheaper varieties of imported meat are the cheapest energy foods.

(3) Tuber vegetables (potatoes, parsnips, etc.) are cheap sources of energy, as are onions and carrots when cheap. In general, however, fresh fruit and vegetables appear among the dear energy foods. (See discussion on Tables V., VI. and VII.).

(4) On the whole, dairy products occupy a very favourable position (see note to III.).

(5) Meats and fish, and especially the latter, are amazingly dear sources of energy a surprising discovery in view of the fact that from 35-40 per cent. of all money which is spent on food is spent on these two items.



Courtesy] [" Diet for the Million," J. S. Bainbridge (Williams & Norgate, Ltd.)

2. Cost of Protein Ration

TABLE IV

Cost of 1 oz. of First-class Protein from Different Foods.

Food.	Cost per lb.	Cost of weight yielding 1 oz. first-class protein.
1. Salt Herring ..	6d.	1¾d.
2. Skimmed Milk ..	1½d.	2¾d
3. Mackerel	5d.	3d.
4. Cheese	1s. 4d.	3½d.
5. Whiting	6d.	3½d.
6. Smoked Haddock	9d.	3¾d.
7. Bloater	9d.	3¾d.
8. Veal, breast ..	10d.	4d.
9. Milk, whole ..	2½d.	4½d.
10. Kippers	10d.	4½d.
11. Cod	9d.	5¼d.
12. Mutton (I.) ..	1s. 4d.	5½d.
13. Lamb (I.) ..	1s. 4d.	5½d.
14. Leg of Lamb (I.)	1s. 6d.	7d.
15. Pork	1s. 6d.	8d.
16. Mutton (E.) ..	1s. 8d.	8d.
17. Halibut	1s. 6d.	8½d.
18. Ham	1s 7d.	8¾d.
19. Leg of Lamb (E.)	2s. 0d.	9½d.
20. Plaice	1s. 0d.	10d.
21. Bacon	1s. 6d.	1s. 1d.
22. Turbot	1s. 8d.	1s. 1½d.
23. Sole	2s. 9d.	1s. 3½d.
24. Eggs	2s. 9d.	1s. 5½d.

The available foods from which the first-class (animal) protein can be secured are somewhat limited in number, but even with a restricted choice the cost of the daily protein ration may vary between 1¾*d.* and 1*s.* 5½*d.* This means that with a family of 4 (man-value 3.26) the *cost of weekly first-class protein required may vary between 3s. 11d. and 33s. 5d.*

3. Mineral Salts

Unless care in the selection of food is exercised, there is a danger that mineral salts and vitamins will not be secured in the required amounts. It is, therefore, worth while to compare the best sources of these requirements in a similar manner to that already used for total energy value and first-class protein content. To increase the value of the tables showing the results of these comparisons, the approximate weight in pounds of each particular food material yielding the daily mineral ration has been inserted (column 2).

PLANNING THE FAMILY FOOD BUDGET—I.
Typical expensive foods with energy values similar to those of the cheaper foods shown on the opposite page.

TABLE V

Cost of Securing Daily Calcium Ration from some Common Foods.

Food.	Cost per lb.	Weight contg. daily ration.	Cost of daily ration.
1. Turnip Tops ..	3d.	12 oz.	2d.
2. Beans, dried ..	2½d.-4½d.	13 oz.	3¾d.
3. Cheese	1/4	4 oz.	4d.
4. Milk, whole ..	2½d.	1.6 pts.	5d.
5. Parsnips	1½d.	5 lbs.	7½d.
6. Cauliflower ..	4d.	2 lbs.	7¾d.
7. Carrots	1½d.	5¼ lbs.	8d.
8. Turnips	1½d.	5¼ lbs.	8d.
9. Oatmeal	2½d.	3½ lbs.	8½d.
10. Figs, dried ..	6d.	1½ lbs.	9d.
11. Wheat, whole ..	2d.	5¼ lbs.	10½d.
12. Peas, dried ..	4d.	3 lbs.	11½d.
13. *Bread, wholemeal* ..	2½d.	5 lbs.	1/-
14. Dates	4d.	3 lbs.	1/-
15. Celery	3d.	4 lbs.	1/0½
16. Spinach	4d.	3¼ lbs.	1/1½
17. Cabbage	2½d.	6¼ lbs.	1/3½
18. Onions	2d.	7¾ lbs.	1/3½
19. *Bread, white* ..	2½d.	9 lbs.	1/10
20. Raisins	6d.	4 lbs.	2/-

TABLE VI

Cost of Securing Daily Phosphorus Ration from some Common Foods.

Food.	Cost per lb.	Weight contg. daily ration.	Cost of daily ration.
1. Beans, dried ..	2½d.-4½d.	14 oz.	2¾d.
2. Oatmeal	2½d.	1 lb.	2½d.
3. Flour, wholemeal	2½d.	1½ lbs.	3¾d.
4. Peas, dried ..	4d.	1 lb.	4d.
5. Lentils, dried ..	4½d.	15 ozs.	4¼d.
6. *Bread, wholemeal* ..	2½d.	2½ lbs.	6d.
7. Fish, cheap ..	4d. up	2 lbs.	8d. up
8. Flour, white ..	2d.	4¾ lbs.	9½d.
9. Cheese	1/4	10 oz.	10d.
10. Parsnips	1½d.	6¾ lbs.	10½d.
11. *Bread, white* ..	2½d.	4 lbs.	11d.
12. Milk, whole ..	2½d.	4½ lbs.	11d.
13. Potatoes	1½d.	9 lbs.	1/1½
14. Carrots	1½d.	11½ lbs.	1/4¾
15. Almonds	1/-	1½ lbs.	1/6
16. Turnips	1½d.	13 lbs.	1/7½
17. Figs	6d.	3¼ lbs.	1/9½
18. Raisins	6d.	4 lbs.	2/-
19. Eggs	2/9	2½ lbs.	7/2
20. Meat, average ..	1/6	2 lbs.	3/1

TABLE VII

Cost of Securing Daily Iron Ration from some Common Foods.

Food.	Cost per lb.	Weight contg. daily ration.	Cost of daily ration.
1. Beans, dried ..	2½d.-4½d.	7½ oz.	1¼d.
2. Peas, dried ..	4d.	9½ oz.	2½d.
3. Flour, wholemeal	2½d.	1½ lb.	3¼d.
4. Dates	3d.	19½ oz.	3¼d.
5. Spinach	4d.	15 oz.	3¾d.
6. Potatoes	1½d.	3 lbs.	4½d.
7. *Bread, wholemeal* ..	2½d.	2½ lbs.	6¼d.
8. Figs	6d.	18 oz.	6¾d.
9. Cabbage ..	2½d.	3¾ lbs.	9d.
10. *Bread, white* ..	2½d.	3 lbs. 11 oz.	9¼d.
11. Carrots	1½d.	6 lbs. 10 oz.	10d.
12. Prunes	9d.	1 lb. 2 oz.	10d.
13. Parsnips	1½d.	6 lbs. 10 oz.	10d.
14. Raisins	6d.	1¾ lbs.	10½d.
15. Currants	8d.	1 lb. 5 oz.	10½d.
16. Turnips	1½d.	8¼ lbs.	1/0½
17. Onions	2d.	6 lbs. 10 oz.	1/1
18. Fish, cheap ..	4d. up	3 lbs.	1/2 up
19. Almonds	1/-	1¼ lbs.	1/7
20. Meat, average ..	1/6	1 lb. 2 oz.	1/9
21. Milk, whole ..	2½d.	13¼ lbs.	2/9½
22. Cheese	1/4	2½ lbs.	3/5

Three points are brought out quite clearly by an examination of Tables V. to VII. :—

(1) The very favourable position occupied by milk and dairy products. Their value as a source of energy and of first-class protein has already been stressed, and it is obvious that as sources of phosphorus and calcium they occupy a position which can hardly be taken by any other food. The iron content is low, but the little iron that milk and cheese contain is in a form that can readily be utilised by the body. In the case of meat and some other foods, the iron is present mainly in hæmoglobin (the red colouring matter of the blood) or in some other form which cannot be easily, and is certainly not wholly, used by the body.

(2) The advantages of wholemeal bread and cereals over white flours, etc. As sources of all three elements under discussion, wholemeals appear much nearer the beginning of the tables than do refined products. Where economy is necessary, the use of wholemeal

PLANNING THE FAMILY FOOD BUDGET—II.

Cheap energy foods. A knowledge of food values enable the housewife to plan a completely adequate diet at the lowest possible cost.

foods may be a valuable safeguard against ill-health.

(3) The great value of vegetables as sources of the mineral salts.

4. Vitamins

As has already been said, it is impossible to give the actual vitamin content of foods, but it is possible to say that some foods are much better sources than others. A list showing the relative vitamin content of the more common foods will be found on page 1294.

5. Acid versus Alkali

We are now almost in a position to frame complete rules from which it will be possible to select a diet satisfying scientific requirements and at the same time adjustable to the amount that can be spent on food. Before we can do this, however, one further point must be made clear. Healthy blood is slightly alkaline and, if health is to be preserved, it must be kept slightly alkaline. To ensure this it is necessary that the diet should consist more of foods which contain an alkaline reserve than of foods which contain an excess of acid-forming substances. Fortunately most foods are quite distinctly one or the other, and can be tabulated as acid-formers or alkali-formers. The correct diet rules, it may be added, are easy to memorise and apply, in spite of the apparent complexity of the problem.

TABLE VIII

Acid-forming and Alkali-forming Foods.

Acid-forming Foods.	Alkali-forming Foods.
Animal fats (except milk and its products)	Milk and its products
Cereal foods	All fruits (except cranberries, plums and prunes)
Eggs	All vegetables
Fish	Especially valuable are :
Meats	Apricots, cabbage, carrots, dates, grapefruit,
Poultry	lemons, lettuce, olives,
Cranberries, plums and prunes	oranges, parsnips, pineapples, potatoes, spinach,
Most nuts	tomatoes and turnips.

Note. Refined cereal foods have a distinctly higher acid excess than the natural wholemeals.

An examination of this table reveals the interesting fact that the foods which contain an alkaline reserve (milk, fruits and vegetables) are also the main sources of vitamins and mineral salts. They have for this reason aptly been described as protective foods; acid-forming foods sometimes being described as destructive foods. Since there is a choice of seventy or more fruits and vegetables it should never be difficult to provide a suitable variety of alkaline-forming foods at a reasonable cost.

THE ECONOMICAL DIET

Items such as rent and rates are permanently fixed, but the question has been raised as to what proportion of the income should be spent on food. Obviously the lower the income the higher will this proportion be, and the following suggestions (by the Russell Sage Foundation) have stood the test of experience :—

Amount to be Spent.

TABLE IX

Percentages of Income to be Spent on Food.

Annual Income	Percentage per year for food.	Total per year for food.	Daily total (family of 5: man-value 3.96)	Cost per 1,000 Calories.
£		£ s.	s. d.	d.
1. 125	55	68 15	3 9	3.8
2. 200	45.6	91 5	5 0	5.05
3. 250	45.0	112 10	6 2	6.25
4. 275	45.0	122 10	6 9	6.8
5. 300	44.6	135 0	7 4½	7.5
6. 375	36.8	138 0	7 7	7.65
7. 500	30.0	150 0	8 3	8.35

Where the cost per 1,000 calories must not exceed 3.8*d*., it is obvious that the number of foods available will be somewhat restricted and, if the average food habits of this country are followed, the resulting diet will be very definitely acid-forming. By restricting the expenditure on meats and fish, however, and increasing the expenditure on fruits, vegetables and milk, a greater variety can be secured, and also a diet which is more in accordance with scientific principles. Comparison of a typical working-class budget with a revised suggestion for the same family will make this clear (Tables X. and XI.). The revised budget has a greatly increased vitamin content; the predominant acid character of the typical budget has been abolished, and the mineral elements supplied have been brought much nearer the desirable standards.

Suggested Diet Rules.

TABLE X.

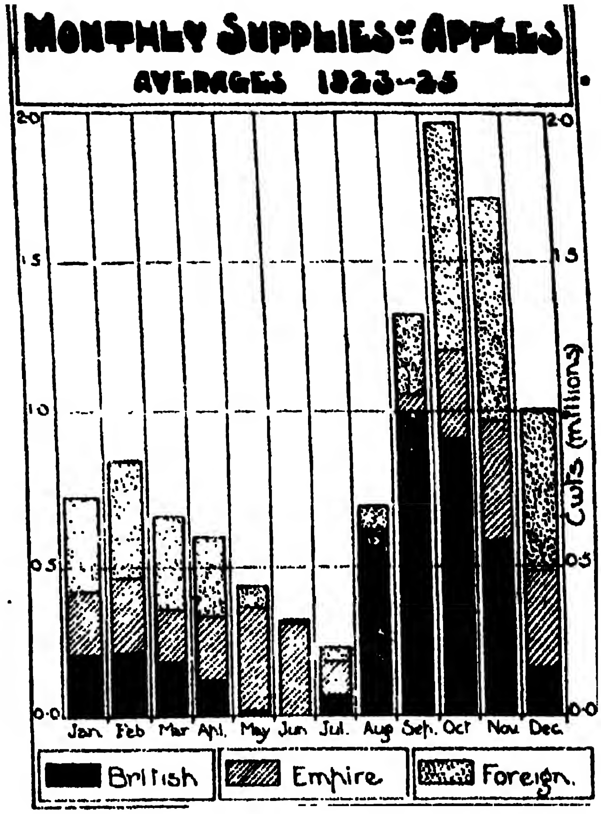
A Typical Working-class Food Budget and its Revision.

Typical Budget.

Food.	Amount.	Cost.
Milk	*6 pints*	1s. 6d.
Milk, condensed	1 tin (6 oz.)	9d.
Sugar	5 lbs.	1s. 4½d.
Beef, imported	4½ lbs.	4s. 10d.
Onions	1 lb.	2d.
Bacon	½ lb.	9d.
Margarine	2 lbs.	1s. 2d.
Potatoes	14 lbs.	1s. 9d.
Jam	1 lb.	10d.
Tea	½ lb.	1s. 0d.
Lard	1 lb.	1s. 4d.
Cheese	½ lb.	7d.
Cabbage	1 lb.	2½d.
Currants	1 lb.	8d.
Flour, white	28 lbs.	4s. 8d.
Dripping	½ lb.	5d.
Oatmeal	2 lbs.	5d.
Yeast	2 oz.	5d.
Rice	½ lb.	2d.
Herrings	1½ lbs.	1s. 6d.
Suet	4 oz.	3½d.
Eggs	3 (6 oz.)	9d.
TOTAL		25s. 6½d.

Revised Budget.

Food.	Amount.	Cost.
Milk	*18 pints*	4s. 6d.
Cheese	1½ lbs.	1s. 5½d.
Cabbage	2 lbs.	5d.
Turnips	2 lbs.	3d.
Potatoes	12 lbs.	1s. 6d.
Spinach	1 lb.	4d.
Onions	1 lb.	2d.
Raisins	1 lb.	6d.
Beans, dried	1 lb.	4d.
Oranges	2½ lbs. (12)	8d.
Apples	2 lbs.	8d.
Herrings	1 lb.	1s. 0d.
Bacon	½ lb.	9d.
Corned beef	1 tin (12 oz.)	9d.
Sugar	5 lbs.	1s. 4½d.
Margarine	2 lbs.	1s. 2d.
Tea	½ lb.	1s. 0d.
Oatmeal	3 lbs.	7½d.
Lard	1 lb.	1s. 4d.
Flour, wholemeal	9 lbs.	1s. 10½d.
Flour, white	14 lbs.	2s. 4d.
Eggs	2 (4 oz.)	6d.
Rice	½ lb.	2d.
Dripping	½ lb.	5d.
Jam	1 lb.	10d.
Yeast	2 oz.	5d.
Macaroni	1 lb.	4d.
TOTAL		25s. 8d.



U. S. Bainbridge, M.Sc.

GREAT BRITAIN'S FRUIT SUPPLY

A chart showing the times of the year at which apples—from different sources—are most plentiful—and therefore cheapest. *(Adapted from the Ministry of Agriculture and Fisheries Report on Fruit Marketing in England and Wales).*

TABLE XI.

Comparison between the Two Food Budgets given in Table X.

	Typical.	Revised.
Cost of 1,000 calories	3.46d.	3.53d.
Calories supplied per day, per man-unit	3,062	3,020
Calcium ration supplied daily	1/50 oz.	1/24 oz.
Phosphorus ration supplied daily	1/16 oz.	1/9 oz.
Iron ration supplied daily	11 mg.*	13 mg.*
Amount spent per week on milk and its products	2s. 10d.	5s. 11½d.
Amount spent per week on fruit and vegetables	2s. 9½d.	4s. 10d.
Amount spent per week on meat and fish	7s. 10d.	3s. 0d.

* 28,350 milligrams are equivalent to an ounce. This is a more convenient method of dealing with the iron requirements than working with a very small fraction of an ounce. The desirable daily ration of iron is 15 milligrams.

A consideration of the last three items in each column brings us finally to the suggested diet rules, *which should be followed whether an economical or a more expensive diet is being planned.*

(1) One pint of milk should be provided per person per day. This should be the irreducible minimum and, in the case of children, an effort should always be made to exceed this figure. It has been shown (Tables III. to VIII.) that milk is the cheapest and best "all round" food available, and it is the food *par excellence* for making good deficiencies in the rest of the diet.

(2) Wholemeal cereals should always be used in preference to refined cereals. They are a much cheaper insurance premium against ill-health, and, in addition to being far more economical sources of vital mineral elements than are refined flours, etc., they contain valuable stimulating roughage and are quite definitely less acid-producing.

(3) The more economical the diet must be, the larger must be the amounts spent on cereal foods. This increased expenditure on cereals must be deducted from the amount spent on animal foods, *and not from that reserved for fruits, vegetables and milk.* Tables X. and XI. show that where strict economy is necessary an expenditure on cereal foods of about 30 per cent. of the food allowance secures a diet which is approximately equal to the theoretical scientific requirements.

(4) Apart from the expenditure on cereal foods, the food allowance should be divided into three approximately equal parts, of which

(*a*) One part, *or more*, should be spent on milk and its products.

(*b*) One part should be spent on fruit and vegetables.

(*c*) One part, *or less*, should be spent on meat and fish.

In all circumstances the maximum possible amounts of protective foods should be used, and the minimum necessary amounts of the destructive or acid-forming foods.

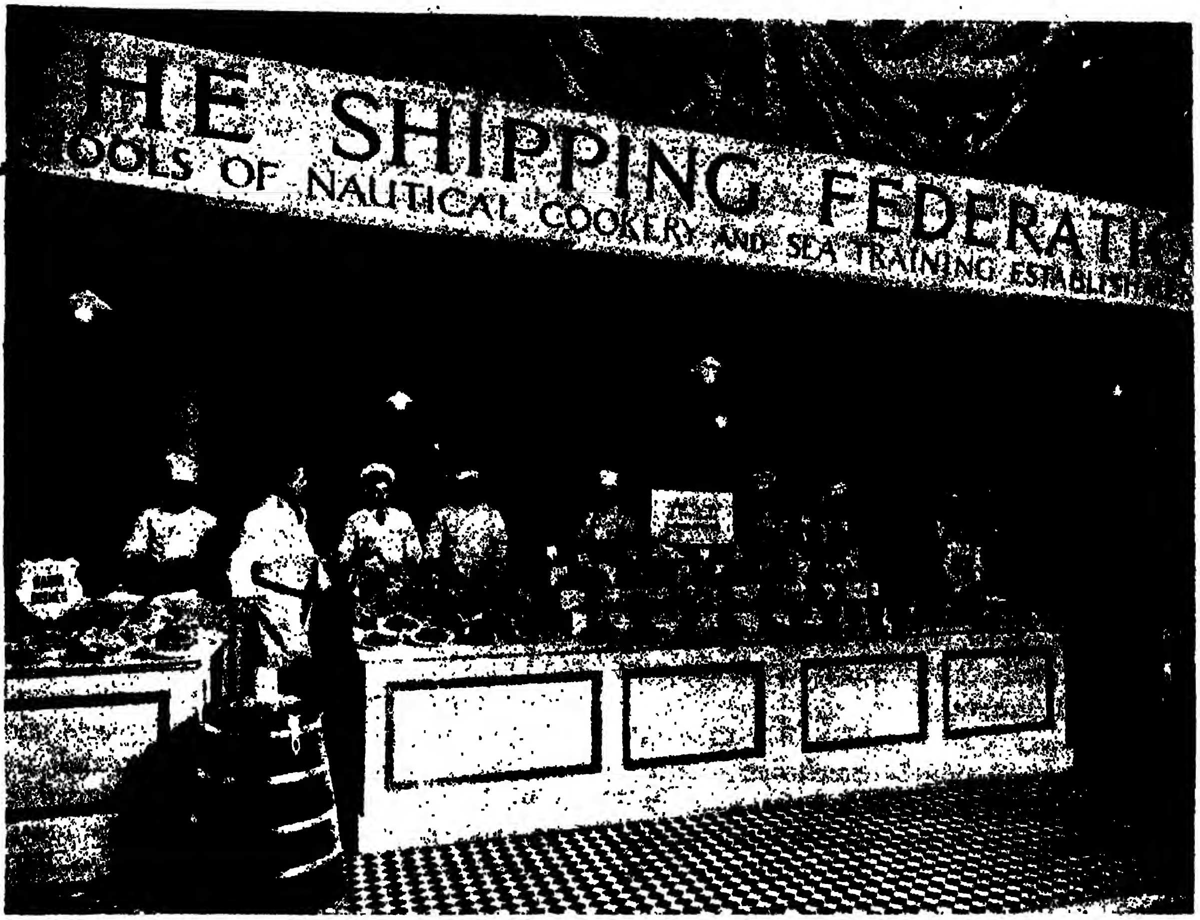
Construction of Menus.

The fact that a selection of food is being bought which, taken as a whole, fulfils scientific requirements, does not entirely solve the problem. Each week has to be divided into seven days, and each day into three meals, all of which have to be satisfying and—equally as important—attractive. Because spinach, for example, is a very valuable food, it might be thought that it should be introduced into the dietary on every possible occasion, in spite of the fact that it is a very difficult vegetable to disguise and, to many people, really repulsive. The skilful cook works on rather different lines and, by serving meals which are at the same time scientifically correct, attractive and varied, achieves her aims without her family even suspecting that they are to some extent subjects of a dietetic experiment.

The type of meal to be provided depends on the season, and on the size and age of the family; but certain broad principles should always be borne in mind when meals are being planned. Every meal, almost without exception, comes into one of two types, (*a*) meals which consist essentially of carbohydrates and fats (such as breakfast) and (*b*) meals in which proteins and carbohydrates predominate (such as dinner). There are sound physiological reasons why meals should not consist of one type of foodstuff only, or why mixtures formed principally of fats and proteins should not be used. The following rules on the construction of menus, adapted from Professor M. S. Rose's *Laboratory Handbook for Dietetics* (Macmillan), should be followed.

First think of each day as a whole, rather than as three separate meals. Then arrange the menus so that the principal types of food material (carbohydrates, fats and proteins) are fairly evenly distributed over the day. For example, do not concentrate all the protein into one meal by serving meat, fish and cheese together.

Next, do not serve the same dish twice on the same day—in fact, except for staple foods such as bread and milk, try to avoid even serving the same food twice. It would be a



Courtesy] [The Shipping Federation

A SCIENTIFICALLY PLANNED DIET

An exhibition showing, in the centre, the statutory scale of provisions on board ship for one seaman for a week.

mistake, for example, to begin dinner with tomato soup if a salad containing tomatoes was to appear later. Each dish should vary in colour and flavour from that served before and after it. Thus a highly-flavoured dish should be followed by a bland and comparatively tasteless one.

Meals are usually digested more easily when they contain at least one warm dish, but when it is desirable that a meal should be light—as lunch for sedentary workers, for example—this warm dish may consist of soup or even of a drink. Except with children and hard manual workers, the heaviest meal of the day should take place in the evening. It may conveniently begin with soup, which in addition to being pleasantly warming, stimulates the production of gastric juice and so enables the stomach to be in the best " frame of mind " for dealing with later courses of the meal. The evening meal may conveniently include two hot dishes, but it should not be needlessly elaborate. There is no point, for example, in serving two green vegetables together, unless one is raw ; or in serving rice with potatoes, since both these are high calorific foods and are used essentially to supply energy. The custom of serving rice separately as a vegetable can, however, be commended.

Summer and winter menus need not differ materially. They cannot, in fact, do so if the advice given in earlier paragraphs of this section is followed. As much raw food as possible should always be taken ; but it is usual to increase the proportion of fruits, salads and light dishes generally in summer, and to provide rather more substantial puddings, etc., in winter.

A NATIONAL EXPERIMENT

By MIKKEL HINDHEDE, Cand. Med., Director of the Danish Laboratories for Research in Nutrition, Copenhagen.

It is a significant fact that man of all animals is the least immune to sickness and disease. Wild animals--according to a German authority--certainly suffer from diseases caused by parasites, poisonous herbs and external injuries in the fight for existence, but are free from what I may call the "diseases of civilisation." Liver, kidney, brain and heart diseases which afflict man between the ages of fifty and sixty are not found in animals living natural lives. Cancer, the dreadful disease which kills 20 per cent. of the male population of Copenhagen over 45 years of age, is almost unknown in wild animals. Neither is it found amongst uncivilised humanity.

The answer to this problem is both simple and--as I shall prove conclusive. Man is the only animal living in a quite unnatural way. Man's wild equivalents--the gorilla and orang-outang live naturally, run about naked, feed on Nature's foods, fruits and vegetables, and are physically much stronger and healthier than his civilised counterpart. A gorilla is five times as strong as a man.

Evils of Civilisation.

How do you think our ancestors lived before they were afflicted (from a physical sense) with civilisation? In the Ladrone Islands (South Seas) until A.D. 1600 the inhabitants, numbering 100,000 people, believed they were the only people in the world. Things we look upon as indispensable were unknown to them. Fire, and its uses, had never been seen; of animals there were none, but a few birds, which they never attempted to capture or eat. They lived on fruit, nuts and vegetables in their raw state. As a result the men were physically perfect. Burdens weighing 500 pounds were handled with ease; diseases were unknown, and senility absent until they reached 100 years or more. Physical fitness was a condition of marriage, and the tests included ability to climb a tree, steer a boat and various other strenuous bodily exercises. In or about 1600 the Spaniards discovered the Ladroners. Civilisation followed; the islanders were forced to clothe themselves, to live in houses, and eat cooked food; meat was introduced into their diet, and alcohol and tobacco forced upon them.

The result of these measures is that in 300 years the population of the Ladrone Islands has decreased from 100,000 strong and healthy people to 9,000 degenerate wrecks. The average death age was 100, now it is 40 years. People living according to Nature's laws are now almost unknown. It is only in the centre of the great islands of the Pacific that they can be found. Civilisation is a curse in so far as physical health is concerned.

The main point of the above description of the Ladroners is not that people, living in Nature's way are destroyed by civilisation, but that the factors which so injure their physical health must be detrimental to civilised people to-day. This is an alarming fact. I shall now analyse some of the more harmful factors of the civilisation of to-day.

First there is the art of cooking. If a person did not get at least one hot meal a day, he would think he was marching to an early death. Why? There is not one fact which can prove that hot or cooked food is better than cold or uncooked food.

My experience, after years of research and observation, is that there is not a better diet than one composed of coarse bread, butter and fruits. In my travels I have often lived for a long time on this diet.

The ingredients are both cheap and easy to obtain. Black bread, butter and bananas are all I want or need. If for a few days circumstances compel me to revert to an hotel diet I do not feel, nor am I, at all well. The chief difficulty in travelling—from a food point of view—is to find a good bread, English bread for instance is very bad.

Soft cooked food spoils the teeth. Professor Blunchli, of Zurich, after some interesting research work in Brazil found that Indian tribes which knew neither cooking, nor flour

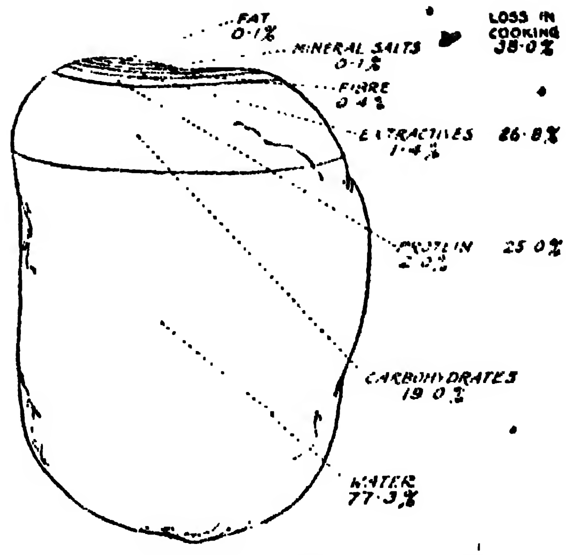
mills, and were untouched by civilisation, had perfect teeth, but, on the other hand, tribes partly civilised for only two generations had hollow and bad teeth.

Let us analyse food. The three main elements in food are proteins, fats and carbohydrates. Food values are measured in calories. A large calorie is the amount of heat required for warming a litre of water to one degree of Celsius. One gram of protein contains four calories (net), one gram of fat, nine, and one gram of carbohydrates, four calories. Protein and carbohydrates have therefore an equal caloric value, but there is this important difference: to buy protein (meat and eggs for instance) costs on an average 10 to 20 times as much as carbohydrates (bread, potatoes, etc.). Why, therefore, do you pay 20 times more for your calories than you need?

The more important reasons include, firstly, the craze for variety in taste of different foods; secondly, custom; and thirdly, that science mistakenly believed thirty years ago that a grown-up man should have 100 grams of digestible protein a days, and that half of such protein ought to be from animal foods which was of much higher value. Recent researches have proved this thirty years old dictum to be wrong. It is not necessary to have *100*, as *20* grams of protein are sufficient, and vegetable and animal proteins have the same value. Therefore we need not worry as to the form in which we get our protein. As long as the food has a sufficient caloric, vitamin, and mineral value the protein fraction need not trouble us.

Science in its experiments of years ago had not man for its model so much as dogs, cats and rats. Rats are certainly interesting animals from the experimental point of view, but, as I often point out when lecturing to farmers, if science were asked to find the food which best suits cows, they would hardly experiment on these smaller animals to obtain their data.

Modern experiments in Denmark have caused some sensation, because in order to find basic food values we used men for



THE COMPOSITION OF A POTATO

The average percentage of the different chemical constituents of a potato (edible portion) and the loss entailed by cooking.

our research work instead of rats. It is an incredible fact that before we began, in 1912, our long researches into the food values of potatoes, this main vegetable had never been scientifically explored as a food for man. The only way to test the value of a food for man is to let him live on it alone for a considerable period. In the case of potatoes, one could add some neutral ingredient such as margarine. In forty years I have made scores of experiments, from which I will select a few examples.

Potato Experiments.

In January, 1912, three men began to live on potatoes and margarine alone. It was with some diffidence that I started this experiment, feeling that it would not succeed. My assistant, Dr. Madsen, first lived on five pounds of potatoes and five ounces of margarine a day in the laboratory, and maintained excellent health. Afterwards I sent him to the country to work as a farm labourer for three months. He had hard manual work for 12 to 14 hours a day, but we increased his ration to eight pounds of potatoes and eight ounces of margarine. His working power, as shown in the report, was amazing. On one occasion he worked for 37 consecutive hours with only one and a

[E N A

VICTIMS OF CIVILISATION

Women of the Ladrone Islands—the native population has degenerated since the introduction of civilised diet and habits

half hours pause for the purpose of eating his rations.

These experiments have been repeated in Germany. Dr. Rose, who for many years was a victim of that most painful disease sciatica, and always carried a gram of morphine in order to commit suicide should the pain become overpowering, submitted himself for nine months to a diet of potatoes and oil alone. This resulted in a complete cure, but on resuming—for scientific purposes—a strong meat diet, the disease returned. As a result he quitted practice, bought an allotment in the country, where he, with his wife and children, have been living on garden products—mostly potatoes—for the past twelve years.

Dr. Rose during his experiments was controlled by the eminent physiologist, Professor Abderhalden of Halle, who wrote: "There is no longer any doubt that it is possible to live on potatoes alone. The potato is a complete nutriment." Professors Hochhaus and Foster at the Holmer Municipal Hospital during the war made many experiments with pure potato diet on their patients. They wrote confirming the accuracy of my statements. In short, they stated that while there was no method of confirming my cost figures, they had to accept the fact that a pound of potatoes has the same food value as a pound of lean meat. It is a mistake, after cooking potatoes, to throw away the water, as this should be used for vegetable soup, as it contains valuable food materials such as vitamins and salts.

Finally, it is interesting to note that not only is it possible to live on potatoes, but to live on a kind poor in protein. On this diet Dr. Madsen subsisted on 22 grams of protein, net, or about one-fifth of the standard prescribed as essential by the older scientists.

Bread Experiments.

Two men lived for about eight months on wholemeal wheat bread and margarine. On this diet they felt unusually well, but on reverting to ordinary white bread, they became so weak and dizzy that they were scarcely able to move. What, therefore, is the difference between the two? The whole feature seems to be that the bran, or outer coat of the grain, which is one of the best foods, is omitted from white bread. Bran contains the best kind of protein, most of the mineral salts and all the vitamins. Why then, should this part of the grain be given to the cows?

Some scientists maintain that men are

unable to digest bran, but this our experiments prove to be a mistake. Man has—as far as bran is concerned—an equal digestive power to that of a pig, and nearly as good as that of a cow. This may seem incredible, but our results have been checked and confirmed by Professor Wiegner of Zurich and Professor Johnson of Stockholm.

Bread, however, contains far more protein than is necessary. On a pure bread diet we cannot get below 50-60 grams of protein. In order to get lower, we have to introduce foods with little or no protein. Prunes cooked as porridge with sugar and starch were introduced, and we succeeded in getting down to 22 grams of protein net. This gave an equivalent number of grams of protein as in the case of potatoes. The men lived on this diet for six months and enjoyed good health. Their working power was unusual. One of them, after the experiments had finished, walked 262 miles in four days—without training. A diet poor in protein, therefore, seems to increase working power. This fact has been confirmed by Chittenden and Irving-Fisher.

During the war an acute problem in Germany concerning the amount of fat required presented itself. It was thought that many war diseases were caused through lack of butter or other fats. Our experiments, however, proved the contrary. A diet composed of cabbage soup with potatoes eaten with bread, was given to two men three times a day for two years. There was a slight variation in the spring when rhubarb and in the autumn when apple was substituted for cabbage soup. The men remained in good health, and one of them increased 20 lbs. in weight in the first nine weeks. In 1918, on publishing the fact, "Fat is not necessary—green vegetables can replace fat," condemnation from physiologists resulted, but now it is generally accepted. The question involved is not "fat or no fat," but whether the food contains certain fat vitamins. These are found in greens as well as in butter.

This is significant, it solves the problem of over-population. Denmark, if the whole animal population lived only on bread, porridge, potatoes and vegetables could feed on their own produce twenty millions of people. Germany similarly could feed two hundred millions and Great Britain one hundred and thirty-five millions. The latter

[E.N.A.]

HARVESTING POTATOES IN DENMARK

The crop which became a staple article of diet in Denmark during the war, with beneficial effects upon the health of the nation.

country imports most of her food for her large population of forty-five millions. It is dreadful also, when we think that during the war, people in Germany were unnecessarily starving because of the false scientific theories of food values.

According to the structure of his teeth man seems to be mainly a fruit eater. On feeding men for experimental purposes, over a long period, with fruit, they did not keep at all well, and their condition was not to be compared with the results after a bread or oat diet. A fruit diet, moreover, proved very expensive in Denmark. For a practical vegetarian diet, cereals (bread, porridge, etc.) are essential. An endeavour was also made to live entirely on meat, but this failed dismally, for after three days we were so sick that we could not go on any more. The excess of meat led to excessive intestinal putrefaction and caused diarrhœa with badly smelling fæces. While a pure meat diet is poisonous for men a small amount of meat is not necessarily harmful. Carbohydrates in the form of cereals and potatoes produce acid bacteria which kill the bacteria of putrefaction.

The amount of meat persons are able to consume without illness varies, but most people eat more meat than is necessary. As with meat, so partly with eggs and milk. Milk seems to be a very good food for many people, but has this unfavourable factor that it causes indigestion in a number of cases.

The diet, according to our investigations, which gives best results is one of cereals (bread, oats and barley) potatoes, butter (or margarine) some green vegetables and fruits.

In Denmark, it is a sad thing that we give bran, barley and potatoes, the best of our foods, to the pigs. When the pigs have wasted four-fifths of the nutriment, with all the vitamins and minerals, then we eat the pigs. We, however, never think of poisoning our pigs with beer, whisky, tobacco and coffee, but in order to remain the most sickly animals in the world, we take these ourselves.

A Great Experiment.

In 1917, the State of Denmark gave me an opportunity to try a great experiment on three million people. The blockade put the country in a very serious position. The importation of half the cereals we required was stopped. Drought, to make matters worse, took one-third of our crops. The situation seemed desperate. The solution was easy; we simply slaughtered our pigs and used the pig food thus saved for the people. We reduced our cows by 34 per cent., took the wheat bran and incorporated it in our coarse rye bread. We thus obtained a bread which contained all the rye bran, and 12 to 15 per cent. of wheat bran extra. Probably this was the coarsest bread ever produced. The production of spirits for consumption was forbidden, and we exported our tea and coffee to England.

Our diet was therefore very plain, consisting of vegetable products, milk and butter. Pork was practically unobtainable, and beef was so dear that most people could afford but very little.

The effect of this Spartan diet was remarkable. The mortality rate after a complete year (October to October) fell 17 per cent. The rate was then 10½ per thousand, the lowest death rate ever recorded in any European country. As you well remember the influenza epidemic appeared in the first three months of 1918, which disturbed the whole of the mortality figures for that year. Denmark was, however, the only country which had no higher death rate than before the war. In other countries the rate was 25 per cent. higher.

ARTIFICIAL LIGHT IN FOOD PRODUCTION

By FRANK WOKES, M.Sc., F.I.C.

PERHAPS it is not surprising that the application of artificial light in food production should have originated and developed most rapidly in those northerly countries where there is, during so many months of the year, a shortage of natural sunlight.

Topical

AN IMPORTANT PART OF THEIR DIET

Members of the Children's Republic at Eberswalde, near Berlin, preparing the potatoes which form an important constituent of their daily diet.

Vitamin D. One of the most important functions performed by the ultra-violet rays is the production of vitamin D, an essential food factor which plays a leading part in bone formation and other vital processes, and which is too often deficient in our diet. The actual rays concerned are confined to very narrow sections of the ultra-violet spectrum, lying approximately at 295 $\mu\mu$, 282 $\mu\mu$ and 270 $\mu\mu$. Of these sections, only that at 295 $\mu\mu$ is present in sunlight even under the best conditions, but the other two may be obtained from suitable artificial sources.

Vitamin D is produced by the action of ultra-violet rays of the proper wave-length on a substance known as ERGOSTEROL. Ergosterol is a definite chemical compound belonging to a class of bodies which are given the name sterols. These are complex organic substances found in both animal and vegetable fats. They can be separated from these by treatment with hot alkali, which converts the fats into "soaps," but leaves the sterols in the "unsaponifiable residue." When cod-liver oil, for instance, is thus treated, about one per cent. of it is unsaponifiable, and this fraction contains the sterols and the vitamins. Butter and other natural fats can be subjected to a similar process, and the sterols obtained from the unsaponifiable fraction by further chemical methods.

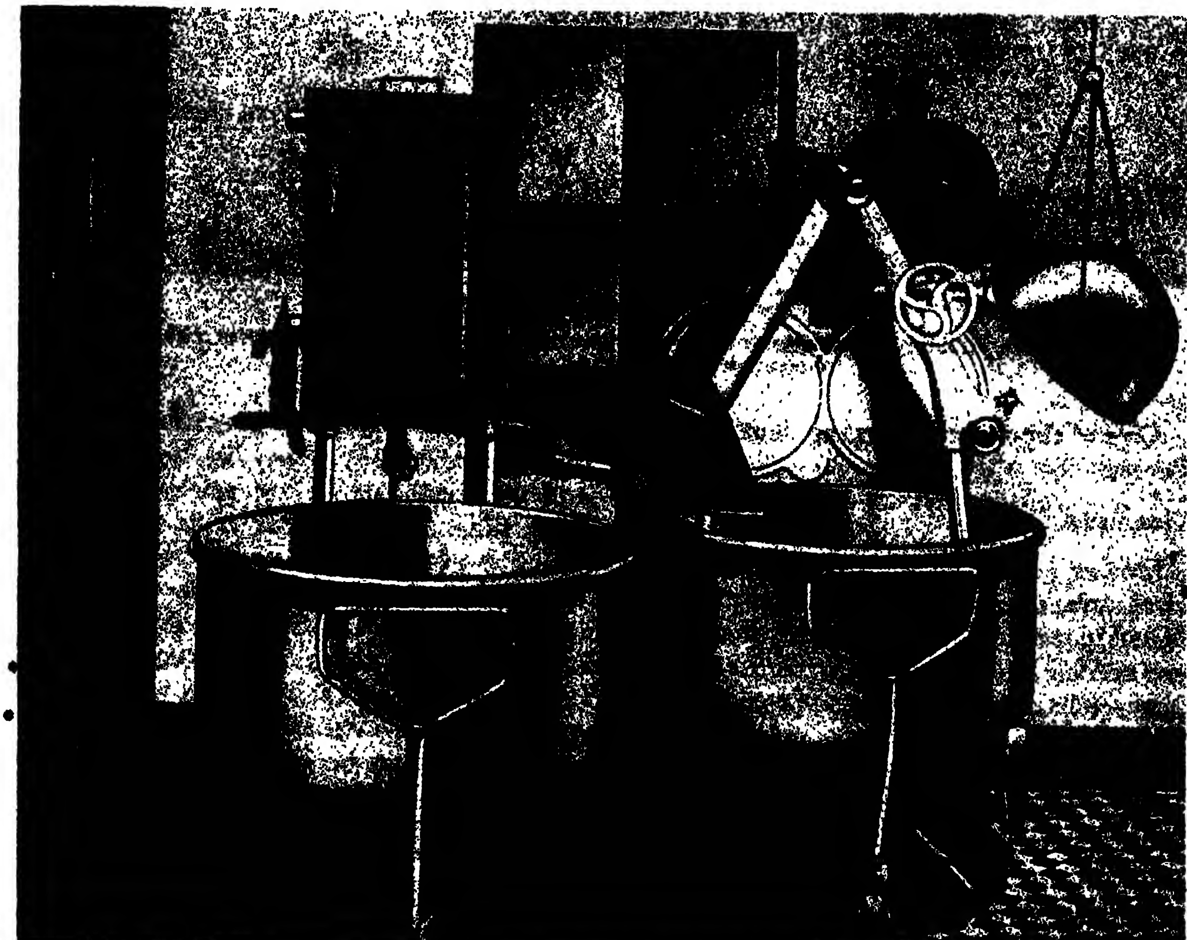
In the case of cod-liver oil, about half the unsaponifiable fraction consists of the sterol, cholesterol. Intermingled with the cholesterol is a very small amount of ergosterol, roughly about 1 part in 2000. So that,

suppose one started with a hundredweight of cod-liver oil, one would obtain from it probably rather less than a pound of unsaponifiable matter. This would contain about half a pound of cholesterol, and in the latter there would be something like *two grains* of ergosterol!

Obviously, this would be a most expensive way of obtaining ergosterol, especially as the chemical processes for separating ergosterol from cholesterol require large quantities of costly reagents. Also ergosterol is a much less stable compound, and readily destroyed by oxidation, particularly at high temperatures. Fortunately, a far superior source of ergosterol has been found in the form of yeast. Yeast, when cultivated under ordinary conditions, contains from ½ to 1 per cent. of fat. Of this roughly a third consists of unsaponifiable matter, which is remarkable for containing nearly half its weight of ergosterol. Thus, from a hundredweight of yeast, there can be obtained between one and two *ounces* of ergosterol, by simple chemical methods employing relatively inexpensive reagents. Yeast as raw material costs much less than cod-liver oil, and yields several hundred times as much ergosterol. This high yield may be further increased by suitable modification of the conditions under which the yeast is cultivated.

Irradiation.

When the ergosterol has been purified by repeated crystallisation, it is converted into vitamin D by exposure to ultra-violet rays of the correct wave-length. This process, which is termed



Courtesy] [*Artofex*

TREATING BREAD WITH ULTRA-VIOLET RAYS

The dough is irradiated during mixing and kneading, and the vitamin D content of the bread is thus assured.

Courtesy] [Foodstuffs Irradiation Co.

AN INSTALLATION FOR IRRADIATING MILK

The Sunray plant in a modern dairy where milk is exposed to ultra-violet rays to increase its vitamin content.

irradiation, requires very careful control. In the first place, ultra-violet rays can destroy the vitamin as well as produce it, and, if due precautions are not taken against this destructive action, the yield of vitamin may be seriously affected. There are two methods of avoiding this. One is to cut out the rays responsible for the destruction. These rays lie mainly between 225 and 270 μμ. If the light from the ultra-violet lamp is passed through a screen of vitaglass, practically the whole of these rays are removed. Unfortunately, vitaglass also absorbs a considerable proportion of the rays between 270 and 300 μμ, so that the employment of vitaglass screens necessitates much longer exposures. A second method is to carry out the irradiation at a very low temperature, using liquefied gases as cooling agents. By this means there has been obtained a preparation of great activity, but it is not yet known if the method could be applied successfully on a commercial scale. At present the usual course is to irradiate for short periods (*e.g.*, half to one hour) in order that time is not given for destruction to set in, although this means that only a portion of the ergosterol is converted into vitamin.

A second difficulty is the fact that ultra-violet light has an action on many liquids which might be employed as solvents of the ergosterol. There are serious objections against applying irradiation to solid ergosterol, and from the point of view of convenience it is usually dissolved in some solvent, which enables the liquid to be stirred or otherwise agitated and ensures that all parts of the material receive the same amount of irradiation. But if ether, for instance, is employed as the solvent, the

action of the ultra-violet rays tends to produce organic peroxides which may cause the gradual destruction of the vitamin. Alcohol, if carefully purified, is probably the most satisfactory solvent yet tested, but further research work needs to be done before the optimum conditions for the production of vitamin D in the laboratory have been ascertained.

It is very likely that light may be thrown on this problem by study of the conditions under which vitamin D is produced in nature. The different pigments in green leaves, for instance, probably function as screens to pick out the rays of the most suitable wave-length. Again, there may be present in the protoplasm certain substances which influence the stability of the vitamin when it has been formed. Or the comparatively large amount of cholesterol in cod-liver oil may play an important part in the vitamin story. All these questions will need to be considered, and put to the test of experiment.

HOW TO FEED THE CHILDREN

By JOHN CAMPBELL, Ph.D.

THE diet of the child from early years to the period of adolescence governs to a greater extent than any other factor the future constitution as an adult.

During these critical years a properly balanced daily food supply lays a solid foundation for future vigour and strength, and assures, under normal healthy environment and conditions, a long life of freedom from many diseases.

The growing years are the most vital in the determination of future good health, and errors of feeding may be followed by grave constitutional defects leaving the system prone to the onslaught of disease.

It is wished earnestly to bring home to mothers, upon whom usually falls the supervision of the children's food, the paramount importance of exercising the greatest attention to the nutrition of their offspring.

Every mother is proud to see her boys grow up to be strong and healthy in all the glory of virile manhood, and their girls glowing with health fit to undertake in time to come the arduous duties of motherhood. It is surely worth while to spend a little time in gaining the knowledge necessary to achieve so splendid an ideal.

The basic principles of food and feeding are really simple and readily understood by those of ordinary education and intelligence, and do not involve, as many people think, obstruse calculations or the study of puzzling scientific formulæ.

A perfect diet, whether for a child or adult, provides in the first place water, the basis of the blood and other fluids that carry the soluble nourishment to all parts of the body and remove the waste products in solution.

A Perfect Diet.

Children should be encouraged to drink plenty of water, either plain or in the form of beverages, and to begin the day with a glassful soon after rising. The action of water is purifying, and helps to keep the tissue poisons in solution, thus allowing them to be readily excreted.

The next constituents of importance are the flesh formers which supply the material for the repair of the existing muscles and the formation of new tissues—represented by such foods as the lean flesh of animals, poultry, fish, cheese, and also in cereals, pulses, milk and nuts.

Then fuel and energy foods in the form of fat, starch and sugar are necessary. These are slowly burnt in the body, producing heat and supplying the sources of muscular activity for the performance of work. Potatoes, sugars, cereals and their many products, flour and bread, rice, tapioca, custard powders, arrowroot and pulses are all sources of these foods.

Mineral constituents in the form of phosphates and other lime, potash and soda salts, essential to the formation of good teeth and bone, and required to replenish blood salts, are supplied by most foods, but particularly by the cereals and pulses, and the special organically combined phosphates concerned in brain and nerve nutrition are found in the germ of cereals, yolk of egg and fish roes.

[E. V. Cutworth

"AN APPLE A DAY"

Roughage is also a necessary constituent of a perfect diet, yielded by the cellulose and fibre of fruits, vegetables and whole cereals. These pass through the system without undergoing digestion, giving bulk to the bowel contents, stimulating the worm-like movements by which the digesting food is passed on to be finally excreted as fæces.

In the absence of adequate roughage in the diet constipation occurs, a most injurious condition and absolutely inimical to good health, and especially so in the case of children. For this purpose fine wholemeal bread is better than white bread.

Finally there are the vitamins, the constituents of food that link up the nutriment with actual assimilation by the tissues. A deficiency of vitamin leads to malnutrition, and the onset of scurvy, rickets, and nervous disorders. The vitamins A and D are associated with the fat of butcher's meat, fatty fish, milk, cream, butter, egg yolk, lettuce, spinach, and the germ and bran of cereals. Vitamin A is specially connected with the growth of the child and D with the prevention of rickets.

Vitamins.

Vitamin B, mainly concerned in the nutrition of brain and nerves and also influencing general nutrition, is found in the germ and bran of cereals—wholemeal and unpolished rice—eggs, dried peas, beans, and lentils, yeast products, fish roe, liver and sweetbread. A deficiency results in the appearance of various nervous disorders, and a flagging of general nutrition.

Vitamin C is yielded by fruit and green salad and cooking vegetables, tubers and roots. If lacking in the diet, scurvy appears of varying severity according to the degree of the deficiency.

The essential vitamins are supplied by most foods as already enumerated, but it is important to note that the following foods are devoid entirely of vitamin—lard, olive oil, vegetable margarine, white fish, meat extracts, malt extract, white flour, white cornflour, polished (white) rice, custard powders, marmalade and jam, egg substitutes, tapioca, sago, and arrowroot, and should therefore be used sparingly and not as staple supplies, but merely as supplementary sources of caloric value and as gustatory adjuncts.*

* See *Vitamins and the Choice of Food*, by Violet G. Plimmer and Prof. R. H. A. Plimmer, D.Sc., (Longmans Green & Co.).

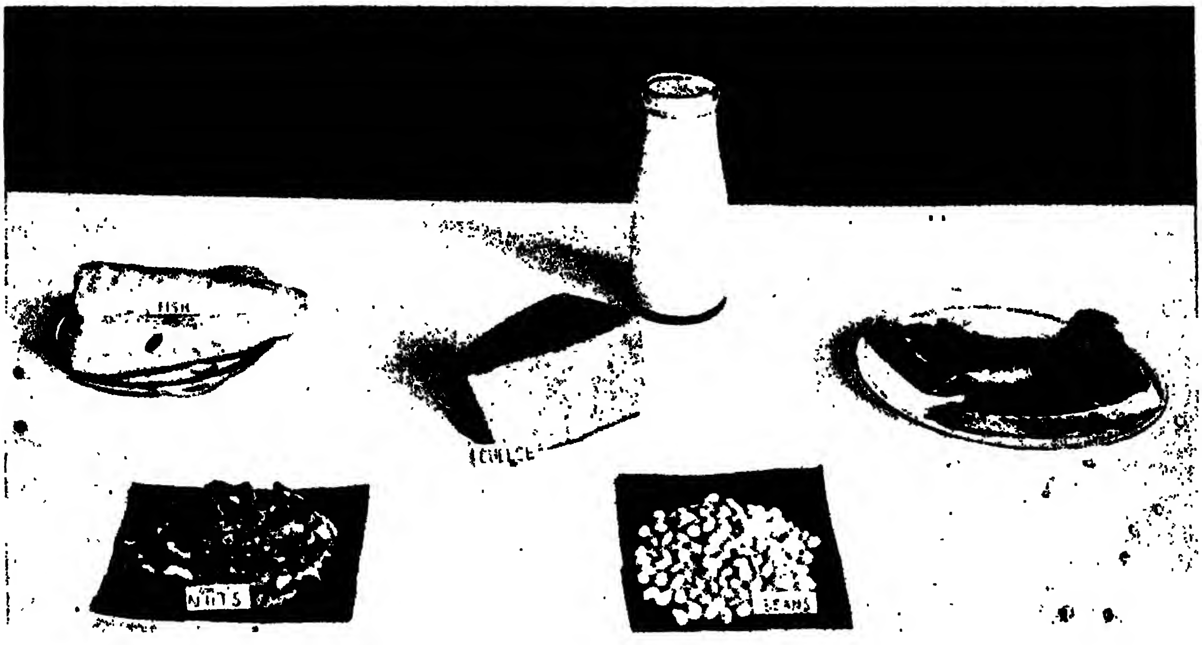
White bread stands in the same category as white flour except that when leavened it requires a negligible quantity of yeast which contains vitamin B.

A perfect diet supplies all these constituents in the right proportion, according to the age, sex, and conditions of life. The normal diet of a child differs from that of an adult in relative quantity and in containing a much higher proportion of flesh-formers, and a fuller complement of vitamin.

Every mother should grasp the fact that her child *is growing* and adding new tissue to its body every day, therefore it requires an increasing quantity of extra flesh-forming foods for that purpose over and above the quota necessary for the maintenance of the existing body.

Then the normal child is very active and needs comparatively more fuel and energy foods than an adult. A normal healthy boy or girl in the early "teens" needs a greater weight of food of the right quality that an adult requires in sedentary conditions of life. From 3000 to 4500 calories, according to age and weight, are required daily. The child's diet must therefore be of generous proportions, and children should be allowed to eat freely at all meals until the appetite is fully appeased. The apparently excessive appetite of children is no cause of uneasiness but is rather to be looked upon as a healthy manifestation of nature.

The foods that should form the bulk of the diet for the young are eggs, milk, cheese, butter, butcher's meat, poultry, fish, peas, beans, wholemeal bread and other whole cereal products, fresh fruit, and salad and cooking vegetables and potatoes. From two to three ounces of fat are needed daily. Part of this will be supplied in the ordinary mixed diet from the fat of butcher's meat, and fatty fish like sardines, herring, bloaters, kippers and salmon, and also from milk, cream, cocoa and chocolate. The major part, however, will be supplied separately as butter, dripping and margarine. Butter and dripping are very good as these fats also supply the necessary vitamins A and D, but vegetable margarine contains no vitamin and should not form the chief source of fat for children. Where from economic reasons the latter is imperative, the child should be supplied with a



THE CHIEF FLESH-FORMING FOODS
Fish, cheese, milk, lean meat, nuts and pulses—body-building foods which should have a prominent place in the children's diet.

teaspoonful of cod-liver oil three times a day.

The fuel and energy foods representing about one pound of dried constituents in the form of sugars and starch are supplied by cane sugar, wheaten breakfast foods, bread, cake, biscuits, porridge, unpolished rice, potatoes, sago, tapioca, and custard powders. The best of these are those that also supply vitamin, *i.e.*, wholemeal bread and cakes, whole cereal breakfast foods, unpolished rice, potatoes and oatmeal porridge.

In the home dietary the mother is able to exercise her personal supervision, but thousands of children from the age of seven upwards are educated in boarding and public schools. It then becomes a matter of vital importance for the parent to ascertain, as far as possible, that the diet is sufficient in quantity and quality.

Home and School.

When selecting a school, parents would be wise to seek the fullest information on the basic diet, as shown in specimen daily and weekly menus, and to submit these to their doctor or other dietetic authority for approval. The official diet of a school should in itself be sufficient in quantity and quality to supply a perfectly balanced diet, without dependence on the extra supplies of milk, eggs, and other foods often paid for or supplied by the parents or bought by the boys themselves.

The weight of the scholar should be regularly checked at the holiday periods, and once or twice a year a medical examination would be a wise precaution.

Courtesy] [*"Good Housekeeping"*

FOOD THE CHILDREN WILL ENJOY

Junket or milk pudding, followed by fruit, is an ideal second course for the children's principal meal.

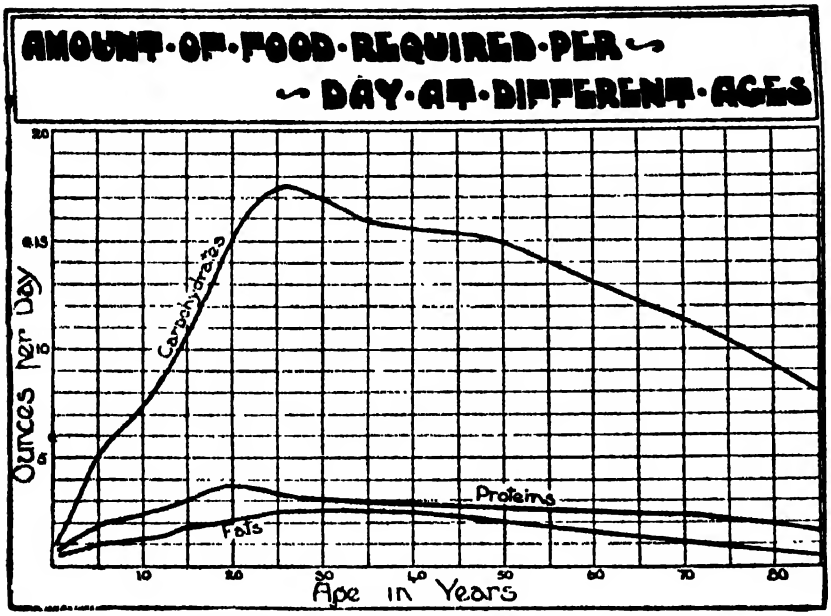
The essential daily requirements of child dietary may be briefly summarised as follows :—

Essential Requirements.

(1) At every meal there should be provided an unlimited supply of fine wholemeal bread (not too new), potatoes with butter or dripping.

(2) There should be a daily ration of from three-quarters to one pint of fresh milk according to the age and digestive capacity of the child. This addition to the daily diet has a beneficial influence on bodily development.

(3) A daily ration of animal flesh-formers either as eggs, cheese, butcher's meat, poultry, fish, or, alternatively, the pulses is necessary in addition to the proportion



Courtesy] [" *Diet for the Million*," J. S. Bainbridge M.Sc. (Williams & Norgate, Ltd.)

THE FAMILY'S DAILY RATION

The figures are relative only, but carbohydrates always form the bulk of the diet, which increases until the adult stage is reached in order to meet the demands of the growing body.

supplied from vegetable sources, *i.e.*, wholemeal bread, macaroni and such like foods.

(4) Every day raw fresh food should be supplied as fruit, in season, and salad vegetables in the form of tomatoes, lettuce, watercress and other varieties as the supplies are available.

For drinking purposes there is nothing better than pure water or diluted natural citrous fruit juice. Cocoa is preferable to tea, though the latter if properly made and not too strong need not be ruled out. In those cases where, notwithstanding a fairly rational diet as indicated, the nutrition and growth appear to flag a little, cod-liver oil should be added to the daily food and a small portion of a pure yeast food extract. Other important points are to allow sufficient time for the meal, and to encourage slow eating to ensure thorough mastication and salivation, and not to serve food in too sloppy a condition. Compact and hard foods are useful in teaching the child to use the teeth and mouth structures properly.

As a general guide the following suggestions are made for the Preparatory and Boarding School age, either at home or away.

BREAKFAST.—Porridge or one of the whole wheaten preparations eaten with milk and sugar, followed by one or more of the following: egg, bacon, fish, fish roes and toast. Wholemeal bread and butter and marmalade *ad lib.* Weak tea, cocoa or milk to drink. Fresh fruit is advisable.

MORNING BREAK.—Milk and wheatmeal biscuits, or bread and butter.

DINNER.—A helping of meat in some form, potatoes, and another vegetable in season, followed by a sweet course in the form of cooked fruit, with a custard dish, or milk or steamed pudding, the latter made with dried fruit and suet. Once or twice a week the meat ration may be replaced by haricot beans as a savoury.

TEA.—Weak tea, cocoa or milk, wholemeal bread and butter, supplemented by one or more of the following: sardines, cheese, jam, savoury pastes, egg salads, and fresh seasonal fruit.

SUPPER.—Very light in quantity. A cup of soup or milk with a slice of wholemeal bread and butter.

The selection is extensive enough to allow of varied meals from day to day and the fresh fruit and salad ration may be worked in as most convenient according to the day's menu.

A haphazard choice of food by the parents may mean the omission of some health-giving substance. The likes and dislikes of the child are not a reliable guide as to which foods to eat and which to avoid. A proper choice cannot be made without a little special knowledge, and if parents will seek and utilise this knowledge they will be rewarded by seeing their children grow up strong, sturdy, happy and free from disease.

FOOD AND DISEASE

FOOD POISONING

By GEORGE SOMERVILLE, *M.D., D.P.M., Deputy Medical Superintendent at the West Ham Mental Hospital.*

ALTHOUGH various diseases may originate from the ingestion of food, the expression "food poisoning" is generally reserved for certain acute illnesses characterised by gastro-intestinal or nervous symptoms which result from eating meat, fish or other animal substances which have been contaminated by certain micro-organisms and in consequence have undergone a varying degree of decomposition or putrefaction.

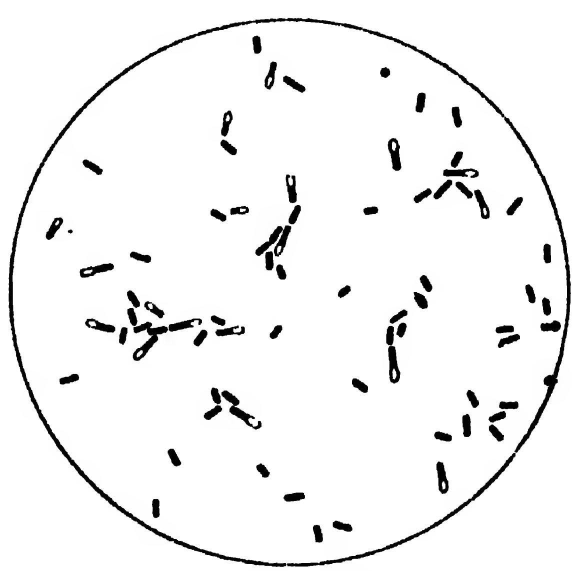
In outbreaks of food poisoning where the gastro-intestinal symptoms predominate, the organisms responsible are the bacillus enteritidis (Gaertner) and the bacillus ærtrycke; they belong to the enteric group and the acute inflammation is due in part to the multiplication of these bacilli in the intestine, and in part to "ptomaines," toxic animal alkaloids which result from the action of bacilli on the albuminous material contained in the food. Certain of these alkaloids have been separated from decaying flesh and have been found to be similar in chemical constitution to the poisonous alkaloids found in many plants. In certain cases no specific organism can be isolated and the poisoning is then presumed to be due either to toxins or to ptomaines originally produced by the bacilli which have since died or have been destroyed in some way, *e.g.*, by cooking. Among the food substances which on prolonged keeping tend to become affected are pork, ham, veal, sausages, tinned meats of all sorts (tongue, sardines, salmon, etc.) meat-pies, shell-fish, cheese and butter. The infected food may be normal in appearance, smell and taste.

Gastro-Intestinal Type.

An outbreak of food poisoning may be suspected when a number of people after consumption of a certain food simultaneously develop an acute illness. Should the bacilli be excreted in the fæces the disease may assume epidemic form; this is peculiarly liable to arise in camps or institutions. Minor degrees of food poisoning are of frequent occurrence and are commonly regarded by sufferers as a slight dietetic indiscretion.

The onset is sudden and severe. Within a short though varying period after a meal there is abdominal pain and tenderness associated with nausea, vomiting and diarrhœa with tenesmus and the evacuation of offensive motions. There may be sweating and shivering, with fever, headache, cramps and a varying degree of prostration. In the majority of cases recovery takes place within a few days, but in some severe cases there may be incessant vomiting and extreme exhaustion which may lead to a fatal termination.

The diagnosis may be confirmed in most cases by bacteriological examination of the stools; the possibility of dysentery and typhoid must be excluded.



CAUSES OF FOOD POISONING—I.
The bacilli which cause botulism—a dangerous form of poisoning sometimes conveyed in canned foods.

In order to remove the infected and decomposing material from the body a purgative, preferably castor oil or calomel, should be administered as early as possible. In serious cases where symptoms arise *immediately* after a meal an emetic is indicated, provided vomiting has not occurred naturally. Should collapse ensue stimulants such as brandy or hot coffee should be given and warmth applied to the body. If vomiting is excessive, the stomach may be washed out and hot applications applied to the abdomen. Diet, so long as the diarrhœa persists, should be of a fluid nature. With severe types irregularity of the bowels in the form of constipation or recurrent attacks of diarrhœa is apt to persist on recovery, and therefore regulation of the bowels by the use of liquid paraffin and control of the diet is advisable.

Nervous Type.

In the nervous type (Botulism : "Sausage Poisoning") the nervous symptoms predominate. The disease is caused by the toxin of an anærobic organism, the bacillus botulinus, which may (fortunately rarely) contaminate uncooked or improperly preserved foods, notably sausages.

The symptoms usually arise in a group of individuals who have partaken of the same food, and are manifested within three or four hours of the repast though there may be a latent period of from twenty-four to thirty-six hours before the typical nervous symptoms appear. Vomiting and abdominal pain may be present, but disturbance of vision, owing to paralysis of ocular nerves, is the characteristic symptom. There is double vision, drooping of the eyelids, dilatation of the pupils and, in severe cases, complete ocular paralysis. Dryness of the mouth and throat is complained of, and there is general muscular weakness. In fatal cases death results from cardiac and respiratory failure.

In treatment an emetic should be given and the stomach washed out ; stimulants must be administered as required. An anti-serum has been prepared and may be of value in the treatment of botulism.

Shell-fish Poisoning.

Certain individuals, especially children, reveal an idiosyncrasy to different varieties of shell-fish ; in other words, on partaking of crabs, lobsters, mussels or oysters such individuals develop unpleasant symptoms which include urticarial or nettle-rashes, gastro-intestinal disorder and, in severe cases, collapse.

Mussel poisoning is caused by a ptomaine, mytilotoxin, produced by bacterial activity (not destroyed by cooking). There is acute collapse with giddiness, coldness, lividity and an itching urticarial rash. Duration is short but death may occur within a few hours.

In treatment the stomach requires to be washed out with large quantities of water ; the sufferer must be kept warm and stimulants freely given.

Oysters "spoil" readily and are liable to produce a gastro-enteritis ; they may convey disease from infection with the typhoid and Gærtner's bacilli.

Grain Poisoning.

Ergotism occasionally occurs from consumption of bread made from rye on which the ergot fungus (Claviceps purpurea) has grown. It has occurred in epidemics in France and Germany during the Middle Ages. The disease is revealed either by the development of gangrenous patches on the toes, fingers and tips of ears, or by spasmodic muscular contractions which may amount to generalised convulsions. Provided the disease has not become chronic, health may be restored if the poisoned bread is excluded from the diet.

Lathyrism is a form of grain poisoning caused by the consumption of cereals to which the powdered seeds of the chick-pea have been added. It is met with in India and Algeria. The disease is revealed in a progressive stiffness of the legs which results in a spastic paralysis.

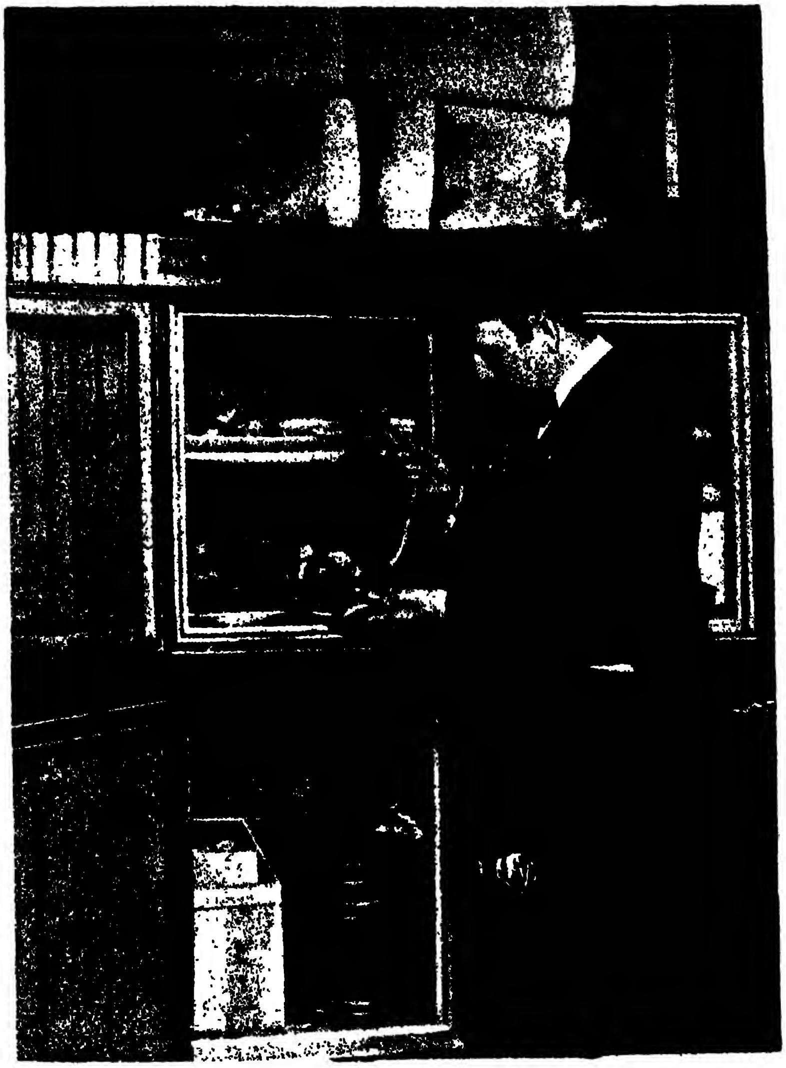
Mushroom Poisoning. (See section on First Aid.)

THE DANGER OF TOO MUCH MEAT

By ARNOLD LORAND, M.D. (Vienna), Physician at the Carlsbad Springs, Czechoslovakia.

Man is mortal, and the most mortal part of his body is his belly. For here, while he is still alive, putrefaction is taking place. And

there are many people who wilfully augment this putrefaction by taking too large quantities of meat in their daily diet. It is meat, which of all kinds of protein food, causes most putrefaction. Eggs cause less of it—especially the yolk of eggs. Similarly cheese, especially fresh cheese; cottage cheese still less, while the least putrefaction is produced, of all protein foods, by the proteids contained in vegetables.



[Keystone

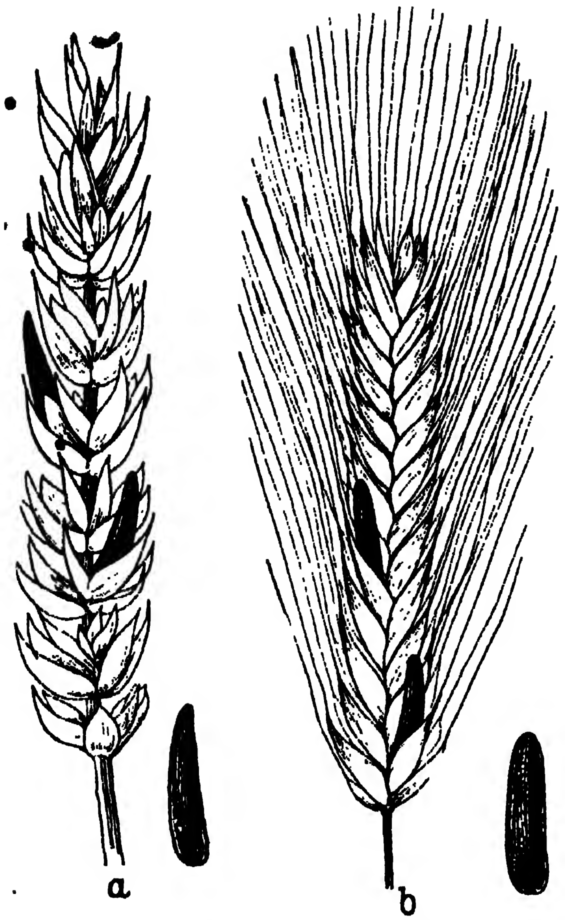
A PRECAUTION AGAINST FOOD POISONING

A food inspector examining sausages in a restaurant refrigerator.

The flesh of young animals causes less putrefaction, for it is more easily digested than that of older animals. Thus beef, which contains more connective tissue and is more difficult to digest and more resistant to the influence of the stomach and intestinal juices and ferments, may cause more putrefaction than veal or chicken. Through cooking, the tender substance of such kinds of meat more easily gives off the extractive substances—the purin bodies which form uric acid and are instrumental in the causation of gout and diseases of the kidneys. The meat of animals that are chased (hunted) is more tough and also contains more of these substances. In their anguish and under the influence of the fear of death they secrete some substances which are most deleterious to our health and augment the process of putrefaction, and for this reason the efforts for more humane methods of killing cattle merit all our sympathy, in the interest of our own health.

Excessive putrefaction in the intestines means auto-intoxication, the source of so many of the diseases man is heir to. It certainly contributes in a powerful degree to the production of arterio-sclerosis. There can be no doubt that those who are eating daily much meat, especially if they are inveterate smokers at the same time, are the surest candidates for this disease.

Besides producing arterio-sclerosis and gout, an abundant meat diet can frequently contribute to the development of diabetes, especially if much starchy food is used at the same time. It is a very instructive fact that statistics on the frequency of arterio-sclerosis, diabetes and gout made in Germany in the years following the last great war showed distinctly that in consequence of the scarcity of food, especially of meat, in the diet, these diseases had greatly diminished



CAUSES OF FOOD POISONING—II.

Ergot, a fungus growth found on rye, wheat, and other plants, which causes "ergotism" when eaten ground up in the flour.

and also caused far fewer deaths than in former years. According to the latest statistics these diseases are getting more frequent again, which, no doubt, is connected with the increasing prosperity and the rich food enjoyed. It may be mentioned that diabetes may also be found in dogs, and then invariably it is only found in dogs which are great meat eaters! Diabetic patients when kept for a certain time on a meatless diet can tolerate a certain amount of starchy food, such as potatoes and bananas, without eliminating sugar.

An abundant meat diet is also very deleterious to the glands of internal secretions, the degeneration of which brings about the symptoms of old age, often at a comparatively early age. These glands, amongst them especially the thyroid, also defend us against the effects of intestinal putrefaction and auto-intoxication. It has also been shown by recent researches that a too abundant meat diet is especially noxious for the functions of the liver, which cannot then fulfil its most important anti-toxic functions satisfactorily.

It is best to take the starchy food not in the form of white bread and pastry, which might be called *dead* starchy food, but rather in the form of brown bread, potatoes and bananas, which contain valuable vitamins and food salts, and which might be called *living* starchy food in contrast to the former. Potatoes and bananas and brown bread with milk together form the basis of a perfect diet, and can also do useful service, especially if dates are added, against intestinal putrefaction and auto-intoxication. An addition of fresh cottage cheese will augment still more the nourishing and wholesome effects of such a diet. Abundant meat is more deleterious to elderly persons, for they are not so well protected by the above-mentioned antitoxic glands as younger people.

Very important also is the proper cooking of the meat. Tender and well cooked meat, boiled or roasted on a slow fire, "mijoté," as the French call it, will certainly be more readily and more thoroughly digested. It is certain that undigested meat, remaining a long time in a lazy colon, is bound to fall a ready prey to the myriads of bacteria which are infesting our colon, and thus to produce an excessive putrefaction and auto-intoxication with all its harmful effects.

Those who are eating a properly cooked fresh and healthy food at their own table have certainly more chance for a long life and a green old age than those who eat the ready menus of cheap restaurants, with food often of a questionable quality and not rendered digestible by the necessary culinary art. Those who eat daily too much meat, especially if they are elderly persons, dig their own graves with their teeth!

CANCER AND DIET

By FREDERICK L. HOFFMAN, LL.D.,
Consulting Statistician to the Prudential Insurance Co., U.S.A.

THE almost universal increase in cancer is related to our modern civilisation. Cancer among native races is relatively very rare when compared with the corresponding mortality from cancer among civilised races in the same areas or countries. Investigation of the negro population of America, the native Indians of the United States and Canada, the negroes of the West Indies, the mixed blood population of Mexico, Central and South America, the inhabitants of the Arctic and those of the Falkland Islands provides evidence, overwhelming and incontrovertible, that given a population living a simple and natural life, the cancer death-rate is invariably low, while conversely, given a population living a typical and intense civilised life, the cancer death-rate is invariably excessive.

Our Indian medical service is reasonably efficient and available to every Indian patient, free of charge. Our Indians generally are not lacking in intelligence, and if suffering from external cancers particularly, they would certainly seek qualified treatment in the advanced stages of the disease. For four months I was in the wilderness of Bolivia and Peru, where I made over 1500 physical examinations of men and women of adult age for anthropometric purposes, but I failed to meet with a single case giving the slightest indication of external cancer, nor did I meet with a complaint to that effect. I interviewed a number of excellent physicians in the regions visited who had had many years of experience with the Indian population, but not one said otherwise than that cancer was almost unknown in his practice.

The question naturally presents itself: what distinguishes native races from people living in a condition of civilisation? The fundamental difference which overshadows every other is that the former live entirely upon a natural food supply, while the latter live now largely upon a modified food supply which differs essentially from the food supply of old. It is not necessary to argue the question as to the specific direction in which the modern food supply fails to meet rational dietary requirements. It is sufficient to point out, as it is generally admitted, that many of the essential mineral salts have been removed in the process of modification or adulteration with possibly serious results upon the human metabolism.

Our dietary studies thus far have been largely limited to calories, to carbohydrates, proteins and fats, which are far less essential for certain purposes than the mineral salts which unquestionably bear directly upon a healthy metabolism. We know that iodine deficiency is the cause of goitre, but we do not know whether potassium deficiency may not be one of the causes of cancer. It is only of late that we have learned about vitamins, and it is too early to draw conclusions, but the evidence is suggestive that dietary errors lie at the root of much of the ill-health which continues to afflict civilised people in contrast to its rarity among native races.

Obviously, the question of dietary errors is not the whole question, for civilised people also suffer seriously from a want of proper exercise, which is essential to keep the body in a thoroughly healthy condition. But every other kind of error in habits or mode of living is offset by the overwhelming importance of a well-balanced diet, which is seemingly impossible in modern life, considering the enormous extent to which foods are artificially conserved, preserved, modified or adulterated.

It is not argued that any particular diet is productive of cancer even if taken in excess, or that abstinence from any particular article of food is likely to be beneficial. It is simply maintained as a matter of everyday observance that our modern food practices differ so enormously from those of previous generations that a qualified examination of the whole subject might possibly provide evidence useful for the purpose of elucidating some of the more obscure aspects of the cancer problem. In any event, it may be

taken as certain that natural food habits are conducive to a low rate of cancer, while civilised food habits are conducive to an excessive rate of cancer.

In a recent report of the Ministry of Health on Diet and Cancer, much is made of the very limited data for monastic orders in Great Britain, but little is made of the much more extended data for monastic orders abroad furnished by the ecclesiastical authorities. The mean annual death-rate from cancer in these orders is surprisingly low, but the data have not been dealt with as thoroughly as would be desirable. They certainly should be published in full so that any one may properly draw his own conclusions. It is certainly not a very satisfactory method merely to compute the proportion of cancer deaths in the mortality from all causes in view of the possibly very abnormal distribution of deaths from other causes than cancer in the monastic population.

In the general population, deaths from accidents, suicides and homicides, for illustration, constitute a considerable proportion of the whole, while such deaths are practically non-occurring in the monastic population. I cannot understand why cancer death-rates were not worked out by divisional periods of life and compared with the corresponding rates for the general population. The investigation is an exceedingly interesting contribution to the subject, and it is to be hoped that some time in the future it will be possible to enlarge upon it and present the data in more detail.

Sir George Newman observes that "One of the commonest prejudices is to assume a causal relation between various habits and customs practised by men and the diseases from which they suffer. Naturally, among such customs, those relating to dietary take a prominent place; it would seem obvious that deviations from the normal working of the body should be related to the nature and quantity of the food consumed." But it is not only a question of the food itself, but the profound question as to what modifications have been introduced which make the flour of one period differ from the flour of another period, and the meat of one differ from another. We are at the mercy of an almost universal process of food manipulation for economic or aesthetic reasons or merely for sales promoting purposes. I do not think, however, that it is a question of

[W. F. Taylor

A NATIVE OF BOLIVIA

A member of a healthy race which lives on a natural diet—cancer is unknown among them.

prejudice, but of common sense observations that dietary changes and changes in habits are considered productive of pathological results, the effects of which are visible on every hand.

Our modern food largely represents a quantity of eatable material the nature of which we do not understand. The conviction is arising that the elimination from this material of many of the mineral constituents of natural foods represents one of the insidious factors responsible for the enormous increase in cancer during the last fifty years. It seems probable that investigation of the racial and dietetic aspects of the cancer problem will prove as productive of practical results as laboratory studies on animals and plants. Progress towards a substantial reduction in the cancer death-rate will not be achieved until more natural habits of eating, plus other natural habits of living, prevail in the population at large.

[E. N. A.

A PROFESSIONAL FASTER

A fasting fakir of Bombay, with his alms bowl and attendant.

FASTING AS A WAY TO HEALTH.

By GEORGE SOMERVILLE, M.D., D.P.M., Deputy Medical Superintendent at the West Ham Mental Hospital.

THE practice of fasting, as a means to purification of body and soul, has taken a prominent place in the ritual of many religions from antiquity to the present day. Not always, however, can the motive be truthfully assigned to a desire for physical and spiritual cleansing. Frequently, to pass into a state of ecstatic exaltation in which visions are seen and messages are given forth, in the hope of acquiring the dignity of a prophet or a seer, has been the chief inducement.

In modern times, the subject of fasting has been thoroughly investigated from a scientific point of view and its value as a health promoting measure in *certain conditions* has been firmly established. Unfortunately, over-estimation of the benefits and ignorance of the limitations of fasting have led to the creation of a cult, the devotees of which indiscriminately practise dietetic restrictions, advantageous no doubt to some, but obviously inapplicable to all.

In this connection must also be mentioned the current fashionable craze for slimness amongst women, the attainment of which is not infrequently attended by grave risks to health. It is thus clear that enlightenment on this important matter is very desirable.

Physiology of Fasting

Starvation is defined as lack of any or all of the elements required for nutrition, though for practical purposes water is excluded, as without it a man cannot live for more than a few days.

The starving individual lives on his own

tissues and has thus been said to be receiving a perfect diet, for he is being nourished at the expense of his reserve stores of food elements and these are called upon in the exact proportions in which they are required.

During a complete fast the body's first call is made upon the glycogen or sugar store of the liver, and when this is used up the tissue protein and fat are drawn upon, as much energy as possible being derived from the fat and as little as possible from the protein. On exhaustion of the fat reserves, protein alone is available and death rapidly ensues. The muscles and glands lose a large percentage of their bulk, while the vital organs, the brain and the heart, are conserved at the expense of the others.

Starvation in Disease.

In the treatment of certain diseases complete fasting for two or three days at intervals is beneficial, but it must always be carried out under the direction of the doctor. Appendicitis, ulceration of the stomach and duodenum, high blood-pressure with overweight, diabetes, chronic kidney disease, migraine, epilepsy and some skin diseases react well to carefully supervised fasts. It is, however, the obese—those who have habitually taken food in excess—who derive greatest advantage from a period of under-nutrition.

Before a systematic reduction of food is undertaken, a thorough medical examination is necessary. The method recommended is that of giving an ordinary mixed diet, but in quantity lessened by measured steps. The basis of the diet is meat and vegetables, though meat is almost entirely excluded if constipation is suffered from. It must be emphasised that it is the total caloric value which counts, and to believe that an obese person can be reduced by eating this and not eating that, irrespective of *amount*, is quite erroneous.

Dangers of Fasting.

The knowledge that fasting, complete or partial, has benefited many overfed and diseased persons has led to its exploitation and abuse. Fasting should be undertaken not for aesthetic but for medical reasons. Those who are really overweight will gain steadily in health and appearance by this practice while those who merely seek a slim figure will become haggard and debilitated.

Concerning "single-food cures," Dr. E. Spriggs in the *Lancet* of March 9, 1929, writes: "Such single food diets are known as orange cures, grape and other fruit cures, potato and vegetable cures, oatmeal cures, etc. These cures are easy to organise. They are mostly forms of partial starvation, in some of which the necessary nitrogenous matter is not supplied, while in others there is vitamin deficiency. They all have one feature—namely, a time limit; the cure is for three weeks or four weeks, as the case may be. It is indeed essential that there should be a limit, for such unscientific experiments continued too long do serious harm. The loss of weight is, for the time, satisfactory and sometimes phenomenal, but as the treatment can have no permanent basis the patient is liable to spend the rest of the year fattening for another cure."

Partial Starvation.

The experiences of the peoples of Central Europe during the Great War illustrate the effects of wholesale partial starvation over a prolonged period. As a result of the food shortage, the average caloric allowance of 2400 fell to between 2000 and 1300, the reduction being chiefly caused by diminution of the carbohydrate and fat fractions of the diet. Grave under-nutrition was the result and this was accompanied by diminished vigour and lowered resistance to disease.

While the value of wisely directed fasting as a curative and preventive measure in certain specified conditions has a sound scientific basis, restriction of diet is not a practice to be indulged in haphazard or for frivolous reasons. By rigidly excluding particular kinds of food the risk of developing a specific food deficiency disease becomes very real, and while realising that in civilised communities there is probably more danger from over-eating than from under-eating, all the evidence goes to prove that under-nutrition in the long run impairs the vigour of the mind and body and prepares the soil for bacterial invasion.

SWEETS AND CHILDREN'S HEALTH

By GEORGE W. FLEMING, L.R.C.P., L.R.C.S., L.R.F.P.S., D.P.H., Medical Officer of Health and School Medical Officer at Todmorden, Yorks.

SUGAR in all its forms, *e.g.*, in tea, cocoa, porridge, jam, sweet cakes, etc., already enters into the ordinary diet. If a child has sugar on its porridge, sugar in its cocoa and jam or marmalade on its bread for breakfast, sugar in some form at lunch and supper, then emphatically that child should not be allowed sweets, as its diet contains sufficient sugar already. If, on the other hand, its diet is short of sugar the deficiency can be made good by allowing it to have two or three sweets per day *after* meals.

It is very important that the child should not be allowed to eat sweets between meals, because sweet-eating between meals is the commonest cause of loss of appetite in children for their ordinary food, without which they do not thrive and become more susceptible to disease. If a child is to be given the best chance of developing in mind and body, it must have a properly balanced diet in conjunction with suitable clothing, exercise and fresh air.

It is frequently said that because sugar is a natural food it can have no evil effects. This argument sounds very plausible at first sight but does not bear examination. To begin with, ordinary sugar and sweets are not natural foods in the true sense. For example, the sugar which a native child could extract by prolonged and exhausting efforts from 2 feet of sugar cane in its natural state would not exceed the amount in a lump of the highly concentrated commercial sugar, of which we commonly take two or three in a single cup of tea, or the equivalent of 4 to 6 feet of the sugar cane in its natural state.

Therefore, it is easy to see that the consumption of two or three pence worth of sweets representing the amount of sugar which can be extracted by vigorously sucking, say, 20 feet of the natural sugar cane is a most unnatural and excessive dose, which would take the native child with the natural product about a week to consume as against a couple of hours or less to devour a bag of sweets.

Sugar is a valuable ingredient of the diet but excessive indulgence in it to the exclusion of other even more important articles of food is harmful. If we take Nature as our guide we will not go far wrong, but it is in our conception of what is natural that we may be led grievously astray. For instance, we may say, and very truly, that milk is a natural food and may therefore be consumed *ad lib*, but we must not go further and say that cream and butter, being derived from milk, are also natural foods and therefore can be consumed *ad lib*. For it must be remembered they are the concentrated fats

WHICH SHALL IT BE?

Children should be encouraged to spend their "sweets" money on fresh fruit, rather than on the goods in the confectioner's window.

(E.N.A.

"NATURE'S SWEETS"

Natives in sugar-producing countries chew the fresh cane all day long without obtaining an injurious quantity of sugar.

including susceptibility to "colds," coughs, catarrhs, enlarged tonsils and adenoids. It also leads to a lowering of the body vitality which makes infection with diseases such as measles, whooping cough, etc., extremely probable. Moreover, it is the commencement of an evil habit likely to persist throughout life to the great detriment of health.

When taking too much sugar, the child is also deprived of the vitamins in the fresh fruit and vegetables, which are so essential to its general well-being by its lack of desire for these things. Similarly the flesh-builders, meat, fish and eggs, are pushed aside by the chronic sweet sucker.

The question so often asked by parents—" Does sugar do any harm to the teeth ?—may be controversial. Experience shows, however, that perfect teeth are rarely found in regular sweet eaters, and very bad teeth are the rule.

Whether sugar decays the teeth directly by its local action upon them or indirectly through interference with the calcium phosphate metabolism or with the desire for a mixed diet, is by no means certain, but unquestionably it is related to dental decay in some way. The child obtains undoubted pleasure from sweet-eating; but strict moderation and the indulgence in these delights after, and not before or between, meals are to be commended.

of milk and no longer in proportion to the other ingredients which keep the balance right, and should not be taken in the same quantities as the natural product from which they come; this is mentioned to emphasise the error of taking the natural quantity of a natural product as correct for a concentrated form of that product. Excessive consumption of sugar is conductive to constipation, as it leaves no residue for the bowels to work upon. It is true that this can be made good by partaking of food which leaves plenty of residue, *e.g.*, fruits and vegetables, but unfortunately these things are scorned by the child satiated with sugar, and constipation is the result and the forerunner of ill-health.

The evil effects of constipation in children cannot be over-emphasised. The inevitable self-poisoning which accompanies this condition is the direct precursor of many of the ailments prevalent at this time of life,